A Guide to Plant Indicators of Moisture for Southeastern British Columbia, with Engineering Interpretations

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A Guide to Plant Indicators of Moisture for Southeastern British Columbia, with Engineering Interpretations

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Introduction

This guide was prepared to assist field personnel in the use of plant indicators for recognizing and evaluating soil moisture conditions.

The presence of excess soil moisture is often the cause of many forest engineering problems (e.g. slumping, compaction, and windthrow). With proper planning and construction techniques such problems can be dealt with successfully. To achieve this, however, the problems must be recognized early in the planning process. At the time of field inspection, temporary seepage and seasonally high water tables are often not apparent but can be identified using plant indicators.

All plants occupy a range of environmental conditions. Some species are restricted to a particular habitat while many others occupy a broad range of habitats. Certain species may be indicative of Biogeoclimatic Zones and Subzones at the broad level while others are restricted to, and thus indicative of, very specific moisture conditions within a particular Subzone.

The value of a particular species as an indicator of soil moisture regime may also vary from one Subzone to the next due to the compensating influence of climate, especially precipitation and evapotranspiration. This is most notable when comparing the habitats of many species in the Wet Climatic Region (ICHb and ESSFb Subzones) with their occurrence in the Moist and Dry Regions (Figure 1). Species which are restricted to wetter sites in the Moist and Dry Regions may occur on a much broader range of sites, including drier sites, in the Wet Region as a result of higher precipitation. This is also important from an engineering standpoint since many practices will have a much greater impact and may require extra care or modification due to the generally wetter soil conditions, resulting from greater precipitation, in the Wet Region.

The plant species included in this book are reliable indicators of the presence of seasonal or permanent water near the soil surface for the indicated Biogeoclimatic Subzone(s). This book does not include either all species present in any one Subzone or all the plants present in Southeastern British Columbia. This is not a plant identification guide, in itself, but should be used in conjunction with the other plant identification guides listed in Appendix 1.

This guide does not replace the publications, "Ecological Classification for the Nelson Forest Region" (Utzig et al, 1978) and "A Field Guide to the Identification and Interpretation of Ecosystems" (Utzig et al, in press); which should continue to be used for the classification of sites.

The information on species habitats used in this publication was assembled from data collected by the B. C. Ministry of Forests, Research Branch in the Nelson Forest Region for the Ecological Classification Program and from field observations by the authors.

How to Use this Guide

1) Determine which Biogeoclimatic Subzone the Site is in.

The first step is to determine the Biogeoclimatic Subzone, by using the appropriate 1:250,000 map of "Biogeoclimatic Units of Southeastern British Columbia" from the B. C. Ministry of Forests. The legend from these maps (Table 1) may be used to aid in this determination, particularly near the boundary of two Subzones, by noting which of the climax and associated tree species are present and which are absent. This procedure is outlined in more detail by Utzig et al (1978 and in press).

A map of the Climatic Regions of Southeastern B. C. (Figure 1) is included here to aid in determining the Subzone. Southeastern B. C. has been divided into three Climatic regions, each encompassing areas of similar climatic patterns and each including a number of Subzones. Each Climatic Region contains a unique elevational sequence of Subzones (see Table 1).

2) Use Plants to Aid in Determining the Moisture Status of the Site.

Having determined the Biogeoclimatic Subzone now find the list of "Plant Indicators of Moisture Classes" for the appropriate Subzone. Note that there are separate lists for each Subzone. These lists each have three columns; shrubs are listed in the left column, herbs in the middle, and mosses and liverworts in the right column.

Determine which, if any, of the plants on the list are present on the site with the aid of the plant illustrations and descriptions contained here and other field guides. For reliable results, more than one plant must be used. The plants listed in each moisture class indicate at least that class or wetter, therefore the wettest moisture class indicated by any species present is the moisture class of the site.

Examination of soil pits or exposed soil profiles is necessary for determining soil texture and offers an opportunity to verify the determination of moisture regime made using plant indicators. In some cases coarse textured soils may have water tables just below the rooting zone that are, therefore, not indicated by the vegetation and can be detected only by excavating a soil pit. On disturbed sites more emphasis should be placed on results gained by examining the soil as many of these indicators may invade drier, disturbed sites or may be displaced by other invader species. Even though the use of plant indicators can be a valuable tool for recognizing moisture regimes, it cannot completely replace the examination of soil materials.

The nine class "Moisture Regime" (hygrotope) scale as used by Utzig et al (1978 and in press) has been condensed into four broader classes for the purpose of this publication. Table 2 describes these moisture classes and their characteristics. The driest class combines Very Xeric (0) to Mesic (4) moisture regimes, and, though species are not listed for this class, may generally be recognized in each Subzone by the absence of the moisture indicator species.

Figure 1 Climatic Regions of Southeastern B.C.

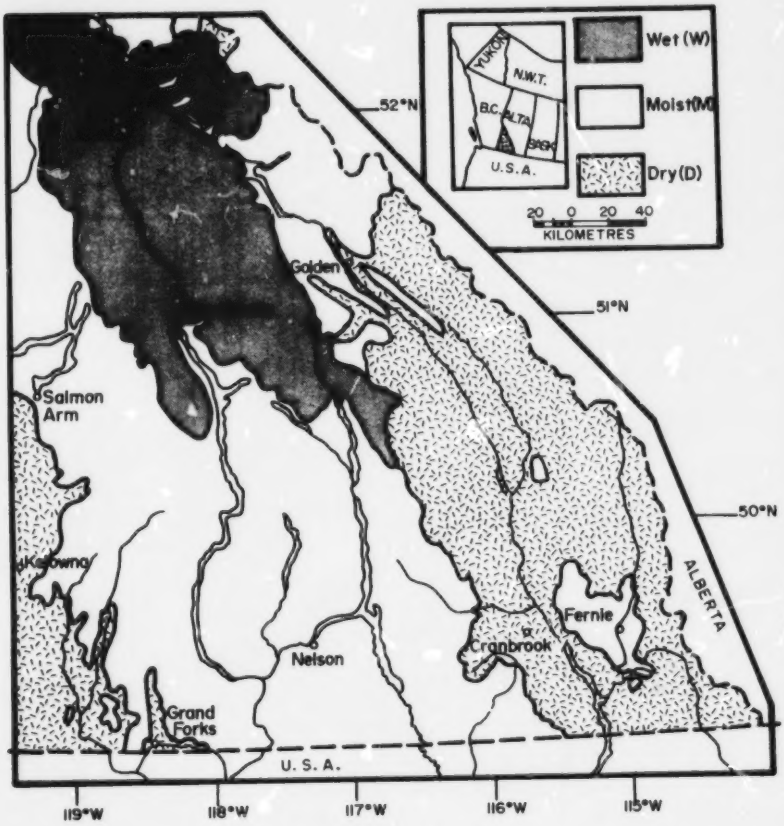


Table 1

Biogeoclimatic Units of Southeast B.C.

BIOGEOCLIMATIC ZONE	CLIMATE REGION	BIOGEOCLIMATIC SUBZONE	MAP SYMBOL	BIOGEOCLIMATIC VARIANT	ZONAL CLIMAX TREE SPECIES	*ASSOCIATED TREE SPECIES	APPROX. ELEVATION RANGES	
							SOUTH ASPECT	NORTH ASPECT
PPBG PONDEROSA PINE - BUNCHGRASS	D	Dry Southern Montane Ponderosa Pine-Bunchgrass Savannah	PPBGc	--------	Py,F	At,Ac,Sw,Se, (Lw),[-Pl]	400-980m (1300-3200')	-------
IDF INTERIOR DOUGLAS-FIR	D	Dry Southern Montane Interior Douglas-fir	IDFf	--------	F	Lw,Pl,Py,Se Sw,At,Ac,Ep, (C)	400-1370m (1300-4500')	400-1280m (1300-4200')
	D	Dry Cordilleran Interior Douglas-fir (IDFg)	IDFg1	Windermere Lake Dry Cordilleran Interior Douglas-fir	F	Sw,Se,At,Ac, (Lw,Pl),[-Py]	600-900m (2000-3000')	-------
			IDFg2	Southern Trench Dry Cordilleran Interior Douglas-fir	F,Py	Sw,Se,At,Ac, (Lw,Pl)	600-900m (2000-3000')	-------
			IDFg3	Kootenay-Columbia Dry Cordilleran Interior Douglas-fir	F	Py,Lw,Pl,Sw, Se,At,Ac,Ep	600-1200m (2000-4000')	600-1100m (2000-3600')
ICH INTERIOR WESTERN RED CEDAR - WESTERN HEMLOCK	M	Moist Southern Interior Cedar-Hemlock (ICHa)	ICHa1	Kootenay-Columbia Moist Southern Interior Cedar-Hemlock	Hw,C	Lw,F,Pl,Py, Se,Pw,Bg,Ep At,Ac,(Bl)	400-1550m (1300-5100')	400-1500m (1300-4900')
			ICHa2	Bush River Moist Southern Interior Cedar-Hemlock	Hw,C	F,Pl,Pw,Se, Bl,At,Ac,Ep, [-Lw]	400-1550m (1300-5100')	400-1500m (1300-4900')
	W	Wet Interior Cedar-Hemlock	ICHb	--------	Hw,(C)	C,F,Pw,Se, Bl,Ep,Ac, [-Pl,-Lw]	400-1350m (1300-4400')	400-1350m (1300-4400')
	M	Moist Cool Southern Interior Cedar-Hemlock (Cedar-Spruce) (ICHc)	ICHc1	Elk River Moist Cool Southern Interior Cedar-Hemlock (Cedar-Spruce)	C,Se	Lw,F,Pl,Py,Ep, At,Ac,(Pw), [-Hw]	400-1550m (1300-5100')	400-1500m (1300-4900')
			ICHc2	West Kootenay-Kickinghorse Moist Cool Southern Interior Cedar-Hemlock (Cedar-Spruce)	C,Se	Lw,F,Pl,Py,Ep, At,Ac,(Hw), [-Pw]	400-1550m (1300-5100')	400-1500m (1300-4900')
	M	Moist Warm Southern Interior Cedar-Hemlock (Cedar-Grand Fir)	ICHd	--------	C,Bg	Lw,F,Pl,Py,Se, At,Ac,Ep, [-Hw,-Pw]	400-1500m (1300-4900')	-------

*- (): rare species, [-]: diagnostic absence of species

- hybridization between Sw and Se is common in any subzone where the two species occur together

† ... may occur rarely in the lower elevations of the ESSFa in the Purcell Mountains

BIOGEOCLIMATIC ZONE	CLIMATE REGION	BIOGEOCLIMATIC SUBZONE	MAP SYMBOL	BIOGEOCLIMATIC VARIANT	* ZONAL CLIMAX TREE SPECIES	*ASSOCIATED TREE SPECIES	APPROX. ELEVATION RANGES	
							SOUTH ASPECT	NORTH ASPECT
MS MONTANE SPRUCE	D	Dry Southern Cordilleran Montane Spruce	MSa	--------	Se,Bl (F)	F,Pl,Lw,At, Ac,Ep,(Sw,C)	1200-1520m (4000-5000')	1100-1400m (3600-4600')
	D	Dry Montane Spruce (MSb)	MSb2	Okanagan Highlands Dry Montane Spruce	Se,Bl (F)	F,Pl,Lw,At, Ac,Ep,(Sw)	1370-1770m (4500-5800')	1280-1670m (4200-5500')
ESSF ENGELMANN SPRUCE SUBALPINE FIR	D	Dry Southern Cordilleran Engelmann Spruce-Subalpine Fir Forested	ESSFa	--------	Se,Bl (Pa)	Pa,Pl,La,At, (F)†	1520-2130m (5000-7000')	1400-2130m (4600-7000')
	D	Dry Southern Cordilleran Engelmann Spruce-Subalpine Fir Parkland	ESSFap	--------	Se,Bl	Pa,La	2130-2600m (7000-8500')	2130-2600m (7000-8500')
	W	Wet Mountain Hemlock-Engelmann Spruce - Subalpine Fir Forested	ESSFb	--------	Se,Bl Hm	(Ac)	1350-1800m (4400-6000')	1350-1800m (4400-6000')
	W	Wet Engelmann Spruce-Subalpine Fir Parkland	ESSFbp	--------	Se,Bl	Hm,Pa	1800-2300m (6000-7500')	1800-2300m (6000-7500')
	M	Moist Southern Engelmann Spruce-Subalpine Fir Forested	ESSFc	--------	Se,Bl	Pl,At,Ac, (F,Lw,Y)	1550-1980m (5100-6500')	1500-1980m (4900-6500')
	M	Moist Southern Engelmann Spruce-Subalpine Fir Parkland	ESSFcp	--------	Se,Bl	La,Pa	1980-2440m (6500-8000')	1980-2440m (6500-8000')
	D	Dry Southern Engelmann Spruce-Subalpine Fir Forested (ESSFe)	ESSFe2	Okanagan Highlands Dry Southern Engelmann Spruce-Subalpine Fir Forested	Se,Bl	Pa, Pl,At	1770-2130m (5800-7000')	1670-2130m (5500-7000')
AT ALPINE TUNDRA	M	Moist Interior Alpine Tundra	ATe	--------	none	none	Variable Min. Elev. 2440m (8000')	
	D	Dry Southern Cordilleran Alpine Tundra	ATf	--------	none	none	Variable Min. Elev. 2600m (8500')	
	W	Wet Interior Alpine Tundra	ATg	--------	none	none	Variable Min. Elev. 2300m (7500')	

*- ():rare species, ∅ - ∃:diagnostic absence of species
- hybridization between Sw and Se is common in any subzone where the two species occur together
† Lw and Hw occur rarely in the lower elevations of the ESSFa in the Purcell Mountains

Plant Indicators of Moisture Classes by Subzone

Climatic Region: Dry

PPBGc

Water at or near the surface all year (7 and 8)

"not defined for this Subzone"

Soil wet most of the year, water within 50 cm of surface all year (6 and 7)

Cornus sericea
Equisetum arvense

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Populus tremuloides
Aralia nudicaulis
Calamagrostis canadensis
Elymus glaucus
Osmorhiza chilensis
Smilacina stellata

IDFf

Water at or near the surface all year (7 and 8)

Carex disperma
Platanthera dilatata
Aulacomnium palustre
Marchantia polymorpha
Sphagnum capillaceum

Soil wet most of the year, water within 50 cm of surface all year (6 and 7)

Viburnum edule
Cinna latifolia
Equisetum arvense
Equisetum sylvaticum
Petasites palmatus
Drepanocladus uncinatus

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Cornus sericea
Lonicera involucrata
Actaea rubra
Galium triflorum
Gymnocarpium dryopteris
Mitella nuda
Pyrola asarifolia

IDFg

Water at or near the surface all year (7 and 8)

Betula glandulosa
Carex aquatilis
Pinguicula vulgaris
Aulacomnium palustre
Sphagnum capillaceum

Soil wet most of the year, water within 50 cm of surface all year (6 and 7)

Viburnum edule
Rubus idaeus
Actaea rubra
Equisetum arvense
Listera cordata
Petasites palmatus

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Cornus sericea
Lonicera involucrata
Aralia nudicaulis
Elymus glaucus
Galium triflorum
Mitella nuda
Oryzopsis asperifolia
Osmorhiza chilensis
Smilacina racemosa
Thalictrum occidentale

Plant Indicators of Moisture Classes by Subzone

Climatic Region: Dry (continued)

MSa

Water at or near the surface all year (7 and 8)

Betula glandulosa	*Carex aquatilis*	*Aulacomnium palustre*
Salix planifolia	*Platanthera dilatata*	*Sphagnum capillaceum*
	Vaccinium oxycoccos	

Soil wet most of the year, water within 50 cm of surface all year (6 and 7)

Ledum groenlandicum	*Actaea rubra*	*Mnium nuchum*
	Calamagrostis canadensis	
	Carex disperma	
	Equisetum arvense	

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Lonicera involucrata	*Aralia nudicaulis*	
Rubus idaeus	*Elymus glaucus*	
	Galium triflorum	
	Mitella nuda	
	Streptopus amplexifolius	

MSb

Water at or near the surface all year (7 and 8)

Betula glandulosa	*Carex aquatilis*	*Marchantia polymorpha*
Salix planifolia	*Eriophorum angustifolium*	*Mnium rugicum*
	Kalmia microphylla	*Sphagnum capillaceum*

Soil wet most of the year, water within 50 cm of surface all year (6 and 7)

Cornus sericea	*Carex disperma*	*Aulacomnium palustre*
Viburnum edule	*Cinna latifolia*	*Drepanocladus uncinatus*
	Equisetum arvense	
	Equisetum sylvaticum	
	Petasites palmatus	
	Senecio triangularis	
	Streptopus streptopoides	
	Trollius laxus	

Soil moist most of year, soil wet during spring and early summer (5 and 6)

	Actaea rubra	*Plagiothecium laetum*
	Adenocaulon bicolor	
	Calamagrostis canadensis	
	Listera cordata	
	Mitella nuda	
	Mitella pentandra	
	Valeriana sitchensis	
	Viola glabella	

Plant Indicators of Moisture Classes by Subzone

Climatic Region: Dry (continued)

ESSFa

Water at or near the surface all year (7 and 8)

Salix planifolia

Carex aquatilis
Kalmia microphylla
Platanthera dilatata
Tofieldia glutinosa
Vaccinium oxycoccos

Calliergon stramineum
Sphagnum capillaceum
Sphagnum squarrosum

Soil wet most of year, water within 50 cm of surface all year (6 and 7)

Carex disperma
Equisetum arvense
Heracleum sphondylium
Mitella breweri
Parnassia fimbriata
Senecio triangularis

Aulacomnium palustre
Drepanocladus uncinatus
Marchantia polymorpha

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Cornus sericea

Actaea rubra
Dryopteris assimilis
Galium triflorum
Gymnocarpium dryopteris
Streptopus amplexifolius
Valeriana sitchensis
Viola glabella

ESSFe

Water at or near the surface all year (7 and 8)

Betula glandulosa
Salix planifolia

Carex aquatilis
Carex disperma
Kalmia microphylla
Platanthera dilatata

Calliergon stramineum
Sphagnum capillaceum
Sphagnum squarrosum

Soil wet most of year, water within 50 cm of surface all year (6 and 7)

Calamagrostis canadensis
Equisetum arvense
Heracleum sphondylium
Ligusticum canbyi
Mitella breweri
Senecio triangularis

Drepanocladus uncinatus
Marchantia polymorpha
Mnium rugicum

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Mitella pentandra
Osmorhiza chilensis
Streptopus amplexifolius
Thalictrum occidentale
Trollius laxus
Valeriana sitchensis

Aulacomnium palustre
Mnium nudum

Plant Indicators of Moisture Classes by Subzone

Climatic Region: Moist

ICHa

Water at or near the surface all year (7 and 8)

Ledum groenlandicum	*Carex aquatilis* *Carex disperma* *Listera convallarioides* *Lysichiton americanum* *Pinguicula vulgaris* *Platanthera dilatata* *Tofieldia glutinosa*	*Drepanocladus uncinatus* *Sphagnum capillaceum*

Soil wet most of year, water within 50 cm of surface all year (6 and 7)

Oplopanax horridus	*Athyrium filix-femina* *Dryopteris assimilis* *Elymus glaucus* *Equisetum arvense* *Senecio triangularis* *Viola glabella*	*Mnium insigne*

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Cornus sericea	*Adenocaulon bicolor* *Aralia nudicaulis* *Asarum caudatum* *Galium triflorum* *Gymnocarpium dryopteris* *Streptopus amplexifolius* *Streptopus streptopoides* *Tiarella trifoliata*

ICHc

Water at or near the surface all year (7 and 8)

Salix planifolia	*Carex aquatilis* *Menyanthes trifoliata*	*Marchantia polymorpha* *Mnium rugicum* *Sphagnum capillaceum*

Soil wet most of year, water within 50 cm of surface all year (6 and 7)

Oplopanax horridus	*Caltha leptosepala* *Carex disperma* *Equisetum arvense* *Equisetum sylvaticum* *Senecio triangularis*	*Aulacomnium palustre*

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Cornus sericea *Viburnum edule*	*Adenocaulon bicolor* *Aralia nudicaulis* *Athyrium filix-femina* *Calamagrostis canadensis* *Dryopteris assimilis* *Galium triflorum* *Gymnocarpium dryopteris* *Listera cordata* *Mitella nuda* *Petasites palmatus* *Pyrola asarifolia* *Tiarella trifoliata* *Trillium ovatum* *Viola glabella*	*Drepanocladus uncinatus* *Mnium nuchen* *Roellia roellii*

Climatic Region: Moist (continued)

ESSFc

Water at or near the surface all year (7 and 8)

Salix planifolia

Caltha leptosepala
Carex aquatilis
Carex disperma
Carex limosa
Drosera anglica
Eriophorum angustifolium
Kalmia microphylla
Platanthera dilatata

Calliergon stramineum
Mnium rugicum
Roellia roellii
Sphagnum capillaceum
Sphagnum squarrosum

Soil wet most of year, water within 50 cm of surface all year (6 and 7)

Calamagrostis canadensis
Equisetum arvense
Heracleum sphondylium
Parnassia fimbriata
Senecio triangularis

Aulacomnium palustre
Marchantia polymorpha

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Oplopanax horridus

Athyrium filix-femina
Cinna latifolia
Ligusticum canbyi
Trollius laxus
Viola glabella

Drepanocladus uncinatus
Mnium nudum

Plant Indicators of Moisture Classes by Subzone

Climatic Region: Wet

ICHb

Water at or near the surface all year (7 and 8)

Carex aquatilis
Carex disperma
Sphagnum capillaceum

Soil wet most of year, water within 50 cm of surface all year (6 and 7)

Equisetum sylvaticum
Heracleum sphondylium
Lysichiton americanum
Platanthera dilatata
Senecio triangularis
Sphagnum squarrosum

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Cornus sericea
Lonicera involucrata
Calamagrostis canadensis
Equisetum arvense
Mitella nuda
Mnium insigne

ESSFb

Water at or near the surface all year (7 and 8)

Carex aquatilis
Carex limosa
Eriophorum angustifolium
Kalmia microphylla
Tofieldia glutinosa
Mnium rugicum
Sphagnum capillaceum
Sphagnum squarrosum

Soil wet most of year, water within 50 cm of surface all year (6 and 7)

Calamagrostis canadensis
Equisetum sylvaticum
Parnassia fimbriata
Trollius laxus
Aulacomnium palustre
Calliergon stramineum

Soil moist most of year, soil wet during spring and early summer (5 and 6)

Actaea rubra
Cirna latifolia
Equisetum arvense
Heracleum sphondylium
Ligusticum canbyi
Senecio triangularis
Viola glabella

Table 2

Characteristics of the Moisture Classes. (Modified from Walmsley et al, 1980)

Moisture Class	Moisture Regime (Hygrotope)	Defining Characteristics		Field Recognition Characteristics		
		Description	Primary Water Source	Meso-Slope Position	Soil Characteristics: Description	Soil Characteristics: Drainage
Soil dry most of year, soil moist during spring and early summer	0 - 4 Very Xeric to Mesic	Water removed readily to rapidly in relation to supply; soil moist for brief to significant part of the year. Available soil moisture is less than or equal to climatic inputs.	Precipitation	Crests to Mid-slopes, shedding to flat	No gleying, possibly mottling over an impermeable layer >50 cm deep.	Very rapidly to Moderately well
Soil moist most of year, soil wet during spring and early summer	5 - 6 Subhygric to Hygric	Water removed slowly enough to keep soil wet for a significant part of the growing season. Temporary seepage near the surface; possibly permanent seepage below 50 cm.	Precipitation and Seepage	Mid to lower slopes, normal to receiving	Mottling present, possibly to the surface; possibly weak gleying below 50 cm.	Moderately well to Poor
Soil wet most of year, water within 50 cm of surface all year.	6 - 7 Hygric to Subhydric	Water removed slowly enough to keep the water table near the surface for a significant period of the year. Permanent seepage or water table less than 50 cm below the surface.	Seepage and permanent water table	Lower slopes, receiving	Mottling present less than 20 cm below surface, gleying present within 50 cm of surface	Imperfect to Poor
Water at or near the surface all year.	7 - 8 Subhydric to Hydric	Water removed so slowly that water table is at or above the soil surface all year. Permanent seepage or water table less than 30 cm below the surface.	Permanent water table	Lower slopes to depressions, receiving to collecting	Gleyed mineral or organic soils	Poor to Very poor

3) Engineering Interpretations

Engineering problems associated with excess soil moisture include windthrow, drainage network failures, frost heaving, compaction, surface erosion and mass wasting. The potential for these problems is also dependent on climate (Subzone), soil texture, depth to impermeable layers and other factors. Engineering Interpretations are presented in Tables 3 to 8, which show the relationship between these environmental factors and each of the potential engineering constraints. The tables show potential hazards which are given as guidelines only. These are not intended to replace field expertise and the consideration of other factors in making final decisions. For more detailed information on the development of these interpretations please contact the Regional Research Pedologist in Nelson. Biogeoclimatic Subzone and moisture regime determine which column is appropriate for the site under consideration. The other factors necessary for deriving a hazard rating are listed in the left-hand column of each table. A guide to determining soil texture is included in Appendix 2 and a guide to Soil Particle-Size Classes is included in Appendix 3. Terms used here are defined in the Glossary of Soil Terms.

The hazard ratings and each of the interpretations are briefly discussed below.

Hazard Ratings

On the interpretation tables relative hazard ratings are given for each constraint in relation to moisture and the other factors. These are defined as follows:

Low Hazard: There is slight or no potential for a problem developing as described. Normal care in planning and management should produce acceptable results.

Moderate Hazard: There is moderate potential for a problem developing under these conditions. Careful planning and management are required, such as special engineering measures or careful timing.

High Hazard: There is a high probability of a problem developing under these conditions. Avoidance of such areas may be necessary or consultation with a soils-engineering specialist may be required to recommend special treatments.

Hazards and Constraints

Windthrow Hazard (Table 3)

Windthrow hazard is often the result of both intensive winds and ineffective tree rooting. Tree rooting habits and their ability to withstand winds are determined in part by genetics and the general condition of the stand but are also strongly influenced by soil texture and available moisture. Rooting depth can be restricted by water tables or impervious soil horizons. In using the accompanying table for windthrow hazard, wind conditions and the susceptibility of particular tree species must also be considered. The assessment of windthrow hazard should be used in the location, size and orientation of cut blocks and the selection of harvesting systems.

Culvert and Ditching Requirements (Table 4)

Drainage requirements are related to the amount of runoff and are determined on the basis of precipitation and snowmelt inputs, the presence and duration of seepage, and inferred infiltration. Soil texture and the presence of impermeable layers are also important to assessing drainage requirements. This information should be useful for road and landing location and in determining drainage structure requirements. The hazard is rated only for the specific site conditions given. In application, consideration must also be given to the effects of diverting water from adjoining areas onto these sites.

Frost Heave (Table 5)

The potential for frost action is primarily dependent on soil texture, the presence of soil water below the freezing level in the soil, and on climatic conditions resulting in numerous freeze-thaw cycles during the year. Problems include increased road maintenance and frost heaving of seedlings.

Compaction (Table 6)

The operation of heavy equipment can cause an increase in soil density and a reduction in soil pore space. This compaction can result in lower infiltration rates, higher runoff and reduced productivity. The potential for soil compaction is determined by soil texture and the soil moisture content at the time the compactive force is applied. The maximum potential for compaction occurs when the soil is moist, but not saturated (ie. moisture content is midway between field capacity and the wilting point, or near the plastic limit; at optimal moisture content). The ratings given are based on the potential for compaction of each soil texture category and the relative frequency with which the optimal moisture content is expected to occur. Any site with moderate or high ratings will have a high hazard during periods following rainfall or snowmelt. At these times travel with heavy equipment should be avoided. Permanent seepage may cause a high compaction hazard except when the ground is frozen.

Surface Erosion (Table 7)

Surface erosion is defined as the detachment and subsequent transport of exposed soil particles by running water. The potential for surface erosion depends on soil texture, slope, vegetation and humus layer cover, and the presence and duration of running water. The ratings given here are based on soil texture, slope and soil moisture regimes, as shown on the table. The ratings assume minimal disturbance of the lesser vegetation and humus layers. Removal of vegetation and humus cover will increase the hazard for surface erosion by at least one class. On the basis of Biogeoclimatic Subzones and the given moisture regimes, natural vegetation cover, thickness of humus layers, and climatic conditions are inferred, though not shown on the tables. Conditions where the surface erosion hazard is moderate or high indicate a need for minimal surface disturbance, careful location and management of drainage systems and possible mulching and revegetation where disturbance cannot be avoided.

Mass Wasting (Table 8)

Mass Wasting is the downslope movement of earth materials under the force of gravity. This includes dry-ravel, debris avalanches, soil creep, slumping and earthflows. Mass wasting potential is determined by soil texture as it relates to shear strength, slope, and the relative frequency with which saturated conditions are likely to occur. Areas of moderate or high hazard will require special care to maintain natural drainage patterns and avoidance of excessive cuts, fills, and sidecasts. Deep rooted trees are often critical to preventing mass wasting. In areas with a high hazard, maintenance of mature forest cover may be necessary. Every effort should be made to avoid disturbance of high hazard areas. Consultation with a soils-engineering specialist is recommended where disturbance of high hazard areas is unavoidable.

TABLE 3 WINDTHROW HAZARD

SOIL CHARACTERISTICS		BIOGEOCLIMATIC SUBZONE AND MOISTURE REGIME											
		PPBGc IDFf & g MSa & b ICHd				ICHa & c ESSFa				ICHb ESSFb & c			
		0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8
Depth to root restricting layer	<.3 m	H	H	H	H	H	H	H	H	H	H	H	H
	.3 - .6 m	M	H	H	H	M	H	H	H	H	H	H	H
	.6 - 1 m	L	M	H	H	M	M	H	H	M	H	H	H
	>1 m	L	L	M	H	L	M	H	H	L	M	H	H

NOTE: Local wind patterns and velocities must also be considered, as well as tree species involved.

TABLE 4 CULVERT AND DITCHING REQUIREMENTS

	BIOGEOCLIMATIC SUBZONE AND MOISTURE REGIME											
	PPBGc IDFf & g MSa & b ICHd				ICHa & c ESSFa				ICHb ESSFb & c			
	0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8
CULVERT AND DITCHING REQUIREMENTS	L	M	M	H	L	M	H	H	M	H	H	H

NOTE: Beware that adjacent road building or other disturbance has not changed natural drainage patterns.

TABLE 5 FROST HEAVE HAZARD

SOIL CHARACTERISTICS		*SEASON	BIOGEOCLIMATIC SUBZONE AND MOISTURE REGIME											
			PPBGc IDFf & g MSa & b				ICHa,b,c,d				ESSFa,b,c			
			0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8
	FRAGMENTAL	$												
		S												
	c.f.>70%	F												
		W					L							
SKELETAL (c.f. 35-70%)	SANDY-	$												
	SKELETAL	S												
	S,LS	F												
		W												
	LOAMY-	$	H	H	H	M	H	H	M	M	H	H	M	M
	SKELETAL	S	L	L	L	L	L	L	L	L	M	M	M	M
	L,CL,SL,SICL SCL,SIL,SI	F	M	M	H	H	H	H	H	H	H	H	H	H
		W	M	M	M	M	M	M	M	M	L	L	L	L
	CLAYEY-	$	M	M	M	L	M	M	L	L	M	M	L	L
	SKELETAL	S	L	L	L	L	L	L	L	L	M	M	L	L
	C,HC,SIC,SC	F	L	L	M	M	M	M	M	M	M	M	M	M
		W												
	SANDY	$												
	c.f.<35%	S												
	S,LS	F					L							
		W												
	LOAMY	$	M	H	H	L	M	H	M	M	M	H	M	M
	c.f.<35%	S	L	L	L	L	L	L	L	L	M	M	M	M
	L,CL,SL,SCL	F	L	L	M	M	M	M	H	H	M	M	H	M
		W	L	L	L	L	L	L	L	L	L	L	L	L
	SILTY	$	H	H	H	M	H	H	M	M	H	H	M	M
	c.f.<35%	S	L	L	L	L	L	L	L	L	M	M	M	M
	SI,SIL,SICL	F	M	M	H	H	H	H	H	H	H	H	H	H
	(and fine sands)	W	M	M	M	M	M	M	M	M	L	L	L	L
	CLAYEY	$	M	M	M	L	M	M	L	L	M	M	L	L
	c.f.<35%	S	L	L	L	L	L	L	L	L	M	M	L	L
	C,HC,SIC,SC	F	L	L	M	M	M	M	M	M	M	M	M	M
		W	L	L	L	L	L	L	L	L	L	L	L	L

*$ - Spring (March 15 - June 15), S - Summer (June 15 - September 15)
F - Fall (September 15 - December 15), W - Winter (December 15 - March 15)

NOTE: bare soils are always more of a hazard to frost heave than vegetated soils or soils with humus layers intact

TABLE 6 COMPACTION HAZARD

SOIL CHARACTERISTICS	*SEASON	BIOGEOCLIMATIC SUBZONE AND MOISTURE REGIME											
		PPBGc IDFf & g MSa & b				ICHa,b,c,d				ESSFa,b,c			
		0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8
FRAGMENTAL	$												
	S												
c.f.>70%	F												
	W												
SKELETAL (c.f. 35-70%)							L						
SANDY-	$												
SKELETAL	S												
S,LS	F												
	W												
LOAMY-	$	H	H	M	M	H	H	M	M	H	M	M	M
SKELETAL	S	L	M	H	M	L	M	H	M	H	H	H	M
L,CL,SL,SICL	F	L	L	H	M	M	M	H	M	M	H	H	M
SCL,SIL,SI	W	L	L	L	M	L	L	L	M	L	L	L	M
CLAYEY-	$	M	M	L	L	M	M	L	L	M	L	L	L
SKELETAL	S	L	L	M	L	L	L	M	L	M	M	M	L
C,HC,SIC,SC	F	L	L	M	L	L	L	M	L	L	M	M	L
	W												
SANDY	$						L						
c.f.<35%	S												
S,LS	F												
	W												
LOAMY	$	H	H	M	M	H	H	M	M	H	M	M	M
c.f.<35%	S	L	M	H	M	L	M	H	M	H	H	H	M
L,CL,SL,SCL	F	L	L	H	M	M	M	H	M	M	H	H	M
	W	L	L	L	M	L	L	L	M	L	L	L	M
SILTY	$	H	H	M	M	H	H	M	M	H	M	M	M
c.f.<35%	S	L	M	H	M	L	M	H	M	H	H	H	M
SI,SIL,SICL	F	L	L	H	M	M	M	H	M	M	H	H	M
(and fine sands)	W	L	L	L	M	L	L	L	M	L	L	L	M
CLAYEY	$	M	M	L	L	M	M	L	L	M	M	L	L
c.f.<35%	S	L	L	M	L	L	L	M	L	M	H	M	L
C,HC,SIC,SC	F	L	L	M	L	L	L	M	L	L	H	M	L
	W	L	L	L	L	L	L	L	L	L	L	L	L

*$ - Spring (March 15 - June 15), S - Summer (June 15 - September 15)
F - Fall (September 15 - December 15), W - Winter (December 15 - March 15)

Note: soils with moderate or high ratings should be avoided when moist or following precipitation at any time

TABLE 7 SURFACE EROSION HAZARD

SOIL CHARACTERISTICS	SLOPE %	BIOGEOCLIMATIC SUBZONE AND MOISTURE REGIME											
		PPBGc IDFf & g ICHd MSa & b				ICHa & c ESSFa				ICHb ESSFb & c			
		0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8
FRAGMENTAL c.f.>70%	0-30												
	30-50												
	50-70						L						
	70+												
SKELETAL (c.f. 35-70%) SANDY-SKELETAL S, LS	0-30												
	30-50												
	50-70	L	L	M	M	L	L	M	M	L	M	M	M
	70+	M	M	M	M	M	M	M	M	M	M	M	M
SKELETAL (c.f. 35-70%) LOAMY-SKELETAL L,CL,SL,SiCL, SiL,Si,SCL	0-30	L	L	L	L	L	L	L	L	L	L	L	L
	30-50	L	L	L	M	L	L	M	M	L	L	M	M
	50-70	L	M	M	M	L	M	M	M	M	M	M	M
	70+	M	M	H	H	M	H	H	H	M	H	H	H
SKELETAL (c.f. 35-70%) CLAYEY-SKELETAL C,HC,SiC,SC	0-30	L	L	L	L	L	L	L	L	L	L	L	L
	30-50	L	L	M	M	L	L	M	M	L	L	M	M
	50-70	L	M	M	H	L	M	M	H	M	M	M	H
	70+	M	M	H	H	M	H	H	H	M	H	H	H
SANDY c.f.<35% S,LS	0-30	L	L	L	L	L	L	L	M	L	L	M	M
	30-50	L	L	M	M	L	L	M	H	L	M	M	H
	50-70	M	M	H	H	M	M	H	H	M	H	H	H
	70+	M	H	H	H	H	H	H	H	H	H	H	H
LOAMY c.f.<35% L,CL,SL,SCL	0-30	L	L	L	L	L	L	L	L	L	L	L	L
	30-50	L	L	M	M	L	L	M	M	L	M	M	M
	50-70	L	M	M	H	L	M	H	H	M	M	H	H
	70+	M	M	H	H	M	M	H	H	M	H	H	H
SILTY c.f.<35% Si,SiL,SiCL (and fine sands)	0-30	L	L	M	M	L	L	M	M	L	M	M	M
	30-50	L	M	M	M	L	M	M	H	L	M	H	H
	50-70	M	M	H	H	M	H	H	H	M	H	H	H
	70+	M	H	H	H	H	H	H	H	H	H	H	H
CLAYEY c.f.<35% C,HC,SiC,SC	0-30	L	L	L	M	L	L	M	M	L	L	M	M
	30-50	L	L	M	M	L	M	M	M	L	M	M	M
	50-70	L	M	H	H	M	M	H	H	M	M	H	H
	70+	M	M	H	H	M	H	H	H	M	H	H	H

NOTE: removal of vegetation and/or humus layers or any drainage diversions will increase the erosion hazard

TABLE 8 MASS WASTING HAZARD

SOIL CHARACTERISTICS		SLOPE %	BIOGEOCLIMATIC SUBZONE AND MOISTURE REGIME											
			PPBGc IDFf & g MSa & b ICHd				ICHa & c ESSFa				ICHb ESSFb & c			
			0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8	0-4	5-6	6-7	7-8
SHALLOW (soils <.6 m deep over impermeable layer)		0-30	L	L	L	L	L	L	L	L	L	L	L	L
		30-50	L	L	L	M	L	L	L	M	L	L	M	M
		50-70	L	L	M	H	L	M	H	H	M	H	H	H
		70+	M	H	H	H	M	H	H	H	H	H	H	H
DEEP (soils >.6 m deep over impermeable layer)	FRAGMENTAL c.f. >70%	0-30	L	L	L	L	L	L	L	L	L	L	L	L
		30-50	L	L	L	L	L	L	L	L	L	L	L	L
		50-70	L	L	L	M	L	L	L	M	L	L	M	M
		70+	M	M	H	H	M	H	H	H	H	H	H	H
	SKELETAL (c.f. 35-70%) SANDY-SKELETAL S, LS	0-30	L	L	L	L	L	L	L	L	L	L	L	L
		30-50	L	L	L	L	L	L	L	L	L	L	L	L
		50-70	L	L	M	M	L	M	M	M	L	M	M	M
		70+	L	M	H	H	M	M	H	H	M	H	H	H
	SKELETAL (c.f. 35-70%) LOAMY-SKELETAL L,CL,SL,SiCL, SCL,SiL,Si	0-30	L	L	L	L	L	L	L	L	L	L	L	L
		30-50	L	L	L	M	L	L	M	M	L	L	M	M
		50-70	L	M	M	M	L	M	M	M	M	M	M	M
		70+	M	M	H	H	M	M	H	H	M	H	H	H
	SKELETAL (c.f. 35-70%) CLAYEY-SKELETAL C,HC,SiC,SC	0-30	L	L	L	L	L	L	L	L	L	L	L	L
		30-50	L	L	M	M	L	M	M	M	L	M	M	M
		50-70	L	M	H	H	M	M	H	H	M	H	H	H
		70+	M	H	H	H	M	H	H	H	M	H	H	H
	SANDY c.f. <35% S,LS	0-30	L	L	L	L	L	L	L	L	L	L	L	L
		30-50	L	L	M	M	L	L	M	M	L	L	M	M
		50-70	L	L	M	M	L	L	M	M	L	M	M	M
		70+	M	M	H	H	M	M	H	H	M	H	H	H
	LOAMY c.f. <35% L,CL,SL,SCL	0-30	L	L	L	L	L	L	L	L	L	L	L	L
		30-50	L	L	M	M	L	M	M	M	L	M	M	M
		50-70	L	M	H	H	M	M	H	H	M	H	H	H
		70+	M	H	H	H	H	H	H	H	H	H	H	H
	SILTY c.f. <35% Si,SiL,SiCL (and fine sands)	0-30	L	L	L	M	L	L	L	M	L	L	M	M
		30-50	L	M	H	H	M	M	H	H	M	H	H	H
		50-70	M	H	H	H	M	H	H	H	H	H	H	H
		70+	M	H	H	H	H	H	H	H	H	H	H	H
	CLAYEY c.f. <35% C,HC,SiC,SC	0-30	L	L	L	M	L	L	M	M	L	M	M	M
		30-50	L	M	H	H	M	H	H	H	M	H	H	H
		50-70	M	H	H	H	H	H	H	H	H	H	H	H
		70+	M	H	H	H	H	H	H	H	H	H	H	H

NOTE: with evidence of past mass wasting, raise the potential hazard rating one class

4) Species Illustrations and Descriptions

This section is intended to aid in the recognition and identification of each of the indicator species. Brief descriptions and illustrations are given to aid in their recognition and, in many cases, note is made of features to use in distinguishing a species from others which are similar. Technical terms used in describing plant structures have been reduced to a minimum. Terms which are used are defined in the glossary.

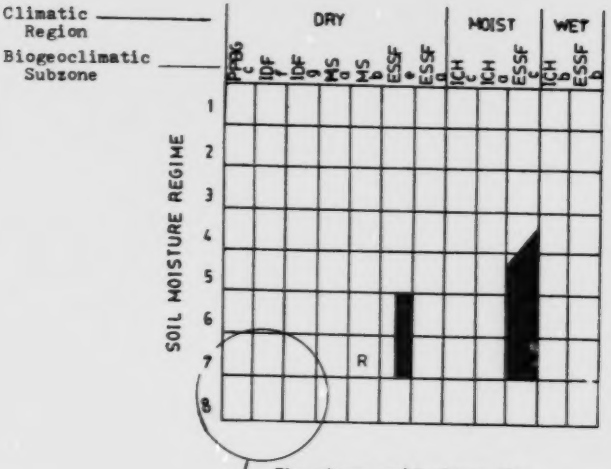
The plant species are arranged in this section according to similarities in appearance and structure. The order is: Shrubs, Herbs (Ferns, Horsetails, Lilies, Orchids, Grasses, Sedges and then Dicots), Mosses and Liverworts. Dicot species are arranged starting with those having simple leaf structure and progressing to those with compound and divided leaves.

The Latin name of each species and the common name according to Taylor and MacBryde (1977) are given, as well as the synonyms used in other plant guides.

The general occurrence and habitat of each of the indicator species is outlined. In addition, some of this information is depicted on a "Habitat Grid". The grid illustrates the general habitat of each species, in relation to Moisture Regime and Nutrient Regime in each Subzone where the species is known to occur. The Habitat Grid and habitat description on each page refer only to the main species described, not to those indicated as notes. Soil terms used in the written description of habitat are defined in the Glossary of Soil Terms.

The "Habitat Grids" are a condensation of the Edatopic Grids used by Utzig et al (1978 and in press). Please refer to these publications for definitions of the Moisture and Nutrient Regimes. On the Habitat Grids, the Biogeoclimatic Subzones are listed across the top according to the climatic Region in which they occur (Figure 2a). Within each Subzone (one column), the Nutrient Regime increases from very poor (oligotrophic) on the left side of the column, to very rich (eutrophic) on the right (Figure 2b). This is repeated in each successive column. Moisture regime is indicated down the left side of the Habitat Grid, increasing from 1 (xeric) at the top to 8 (Hydric) at the bottom.

Figure 2a. Habitat Grid, with examples.



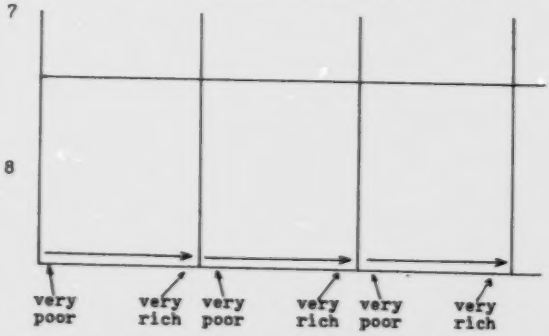
The above grid shows the occurrence of a species in three Subzones:

MSb-"R" indicates that it is rarely found in this subzone; when it does occur it is found on Moisture Regime 7.

ESSFe-it occurs on medium to rich Nutrient Regimes and Moisture Regimes 6 and 7.

ESSFc-it occurs on Moisture Regimes 4, 5, 6 and 7. In Moisture Regime 4 it generally occurs on rich Nutrient Regimes.

Figure 2b. Enlargement of the bottom left corner of the Grid to illustrate Nutrient Regime position



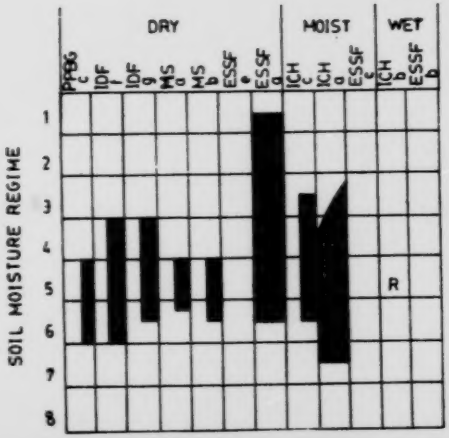
Soil Nutrient Regime, increasing from left to right in each column (Subzone). (very poor=oligotrophic; very rich=eutrophic)

SPECIES ILLUSTRATIONS and DESCRIPTIONS

POPULUS TREMULOIDES Michx. Trembling Aspen

Features:
- -leaves broadly egg-shaped to almost circular, occasionally heart-shaped, paler beneath.
- -petiole from 2/3 as long to nearly as long as leaf blade, glandless, flattened at right angles to leaf blade (a) allowing leaf to flutter in slightest breeze.

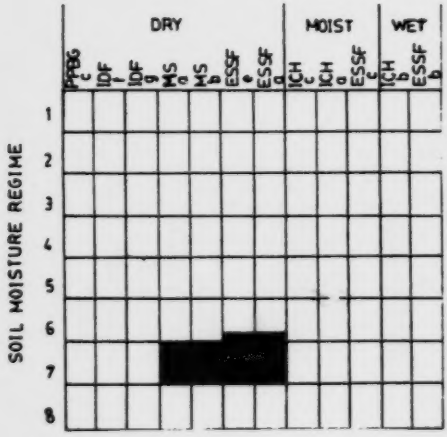
Habitat and Range:
A seral species often associated with abundant soil carbonates. In the PPBGc, it frequently occurs in depressions and on slopes where calcareous layers cause temporary perched water tables. It occurs predominantly on mesotrophic to eutrophic sites with the exception of the ESSFa where it occurs on a wide range of nutrient regimes. Present in all subzones except the ICHb, ESSFb, ESSFc, and ESSFe where it is either rare or absent.

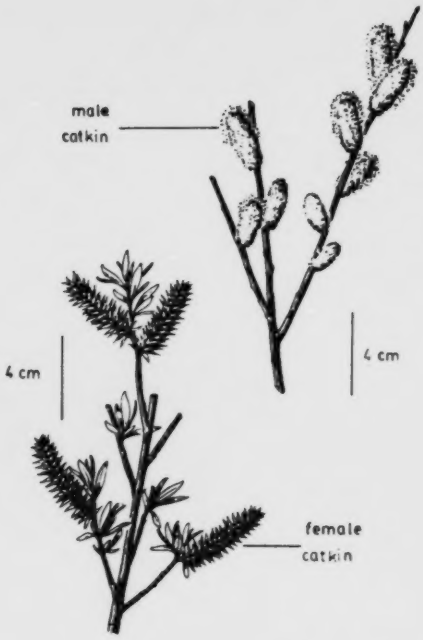


BETULA GLANDULOSA Michx. Bog Glandular Birch

Features:
- twigs densely covered with minute, resinuous, wart-like glands (a).
- thick, leathery leaves almost circular with 10 or fewer rounded teeth on each side, 3 or fewer lateral veins each side, glandular-dotted beneath.

Habitat and Range:
Present on hygric to subhydric sites on organic soils with oligotrophic to eutrophic nutrient regimes. Primarily occurring in bogs in the MSa, MSb, ESSFa and ESSFe.

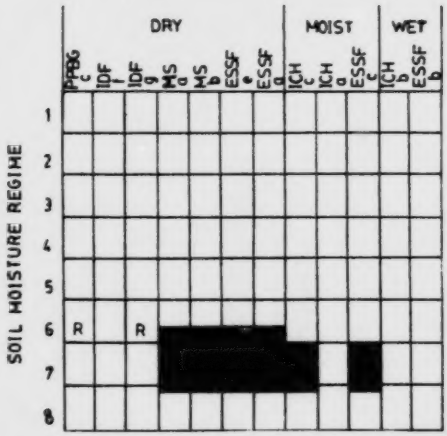




SALIX PLANIFOLIA Pursh — Tea-leaved Willow

Features:
- -twigs shiny, chestnut to deep red or purplish.
- -leaves angularly-oval-lance-shaped to oblanceolate or obovate, whitish beneath, green and shining above.
- -catkins appearing before leaves, stalkless; scales black.

Habitat and Range:
Common in the MSa, MSb, ICHc, ESSFa and ESSFe on hygric to subhydric fens with organic and fluvial soils. No occurrence recorded in the IDFf, ICHa, ICHb and ESSFb.

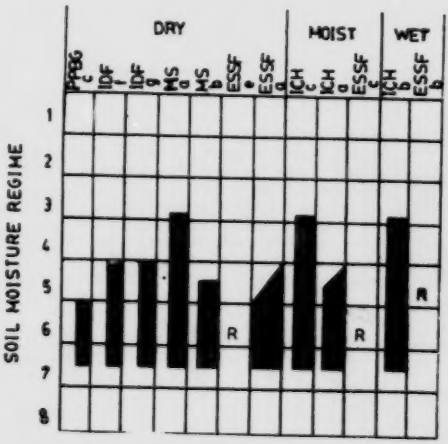


CORNUS SERICEA L.
(*Cornus stolonifera* Michx.)

Red-Osier Dogwood

Features:
- branches bright reddish to reddish-purple.
- leaves opposite, egg-shaped to elliptic-egg-shaped, 4-12 cm long, paler on lower surface, veins prominent.
- flowers (a) white in a flat-topped inflorescence (b).
- berries (c) white.
- leaves have distinctive deep-red colouration in fall.

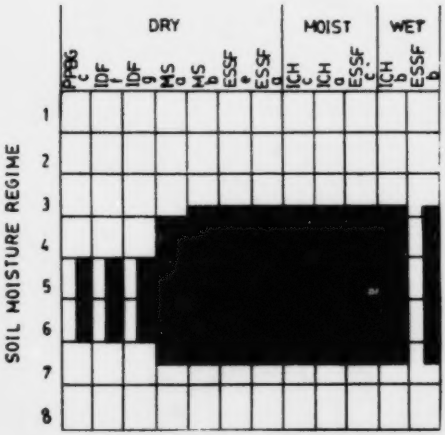
Habitat and Range:
Predominant on floodplains, streambanks and seepage areas with mesotrophic to eutrophic and subhygric to subhydric sites. Also present on drier (submesic) sites in the MSa, ICHb and ICHc where the soils are fine-textured and rich. This species occurs only at lower elevations in subzones of the ESSF.

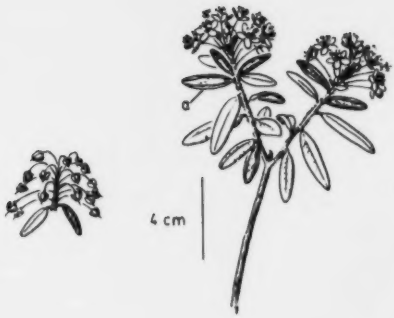


LONICERA INVOLUCRATA (Rich.)Banks — Twinberry Honeysuckle

Features:
- -leaves opposite, elliptic, prominently veined, hairy beneath and along margins, entire.
- -flowers yellow and paired (a), 1 - 2 cm long, swollen on one side (b), flower stems arising in leaf axils.
- -berries black, paired (c), and loosely enclosed by dark-red bracts (d).

Habitat and Range:
Common in all subzones of the Nelson Forest Region. Present on submesic to subhydric and submesotrophic to eutrophic sites in all subzones except the PPBGc, IDFf, and IDFg where it occurs on subhygric to hygric and mesotrophic to eutrophic sites.

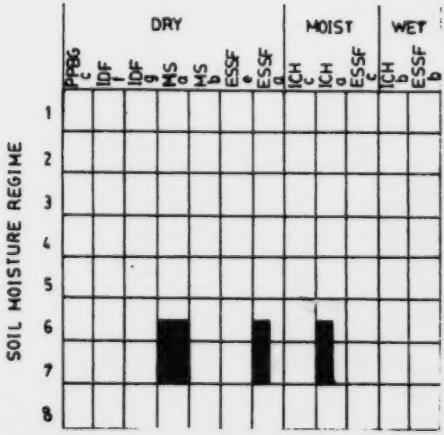


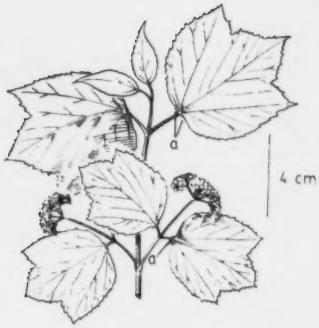


LEDUM GROENLANDICUM Oeder — Common Labrador Tea

Features:
- twigs densely covered in rusty-coloured hairs.
- leaves alternate, fragrant, linear to elliptic, up to 6 cm long, leathery, deep green and smooth above, lower surface covered with a woolly mat of rusty-coloured hairs, leaf margins rolled towards underside (a).
- flowers white in axillary umbels.

Habitat and Range:
Restricted to the MSa, ICHa, and ESSFa where it occurs on subhydric and oligotrophic to submesotrophic (to eutrophic in the MSa) sites with organic and gleyed mineral soils which are generally highly acidic. It is primarily a bog species, usually associated with *Sphagnum capillaceum*.

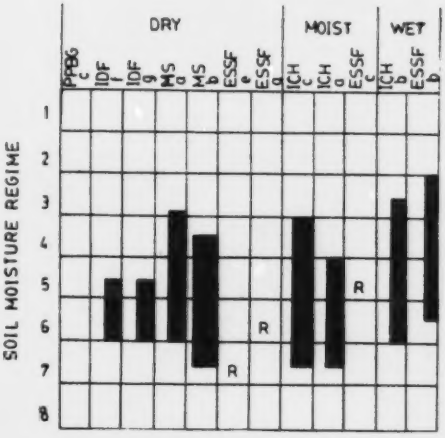


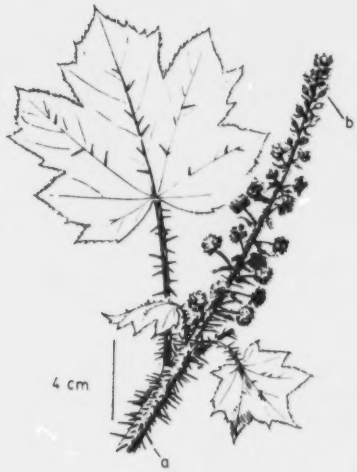


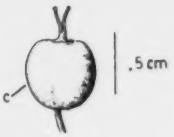
VIBURNUM EDULE (Michx.)Raf. High Bush Cranberry

Features:
-leaves opposite, shallowly 3-lobed, palmately 3-5-nerved, 3-10 cm long, bearing a pair of glandular teeth at junction with petiole (a), hairy beneath.
-berries red or orange, each with one flat seed.

Habitat and Range:
Present on subhygric to subhydric and mesotrophic to eutrophic sites in the IDFf, IDFg and ICHa. This species is common in all other subzones on submesic to subhygric and mesotrophic to eutrophic sites except the subzones of the ESSF where it is rare and the PPBGc where it is absent.







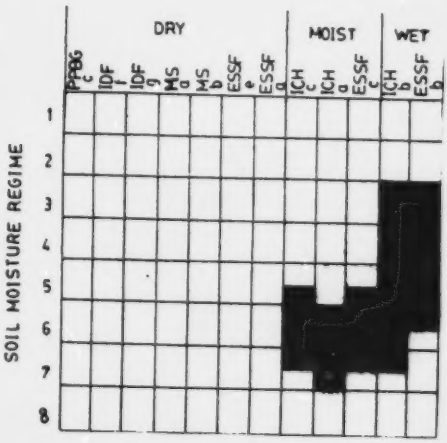
OPLOPANAX HORRIDUS (Smith)Miq. Devil's-Club

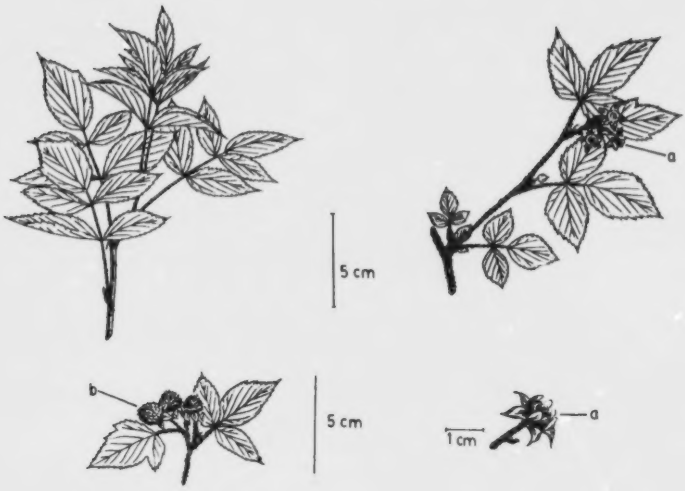
Features:

- stems thick, light brown, 1-3 m high.
- stems, leaf-stems, and leaf veins densely covered with yellowish spines (a) 5-10 mm long.
- leaves alternate, circular-oval, sharply toothed, palmately 7-to 9-lobed, 1-3 dm broad.
- flowers white in large terminal inflorescence (b).
- berries (c) bright red, considerably flattened.

Habitat and Range:

Restricted to the ICHa, ICHb, ICHc, ESSFb and ESSFc where it occurs on subhygric to subhydric and oligotrophic to eutrophic seepage sites in the ICHa, ICHc and ESSFc, and on submesic to hygric sites in the ICHb and ESSFb. This species is usually associated with *Athyrium filix-femina* and *Viola glabella*.





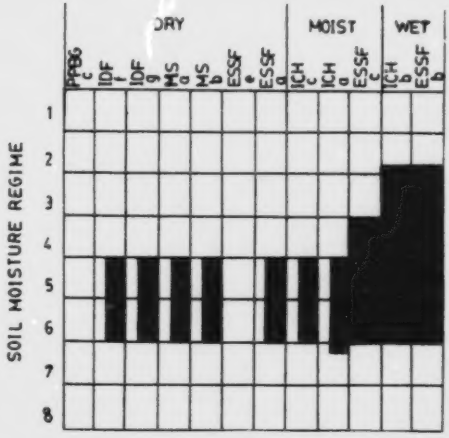
RUBUS IDAEUS L. American Red Raspberry

Features:

- -Canes prickly and bristly; bark yellow to cinnamon-brown, coming off in thin layers.
- -leaves with three to seven leaflets, coarsely doubly-toothed.
- -flowers (a) several, white.
- -fruit (b) red.

Habitat and Range:

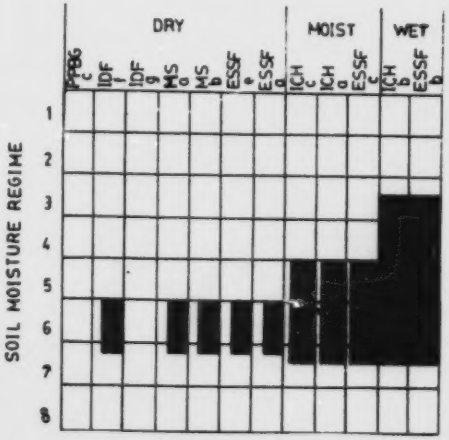
Present in all subzones except the PPBGc and the ESSFe. Found on subhygric to hygric and mesotrophic to eutrophic fluvial sites in the IDFf, IDFg, MSa, MSb, ICHa, ICHc and ESSFa. Also present on subxeric to subhygric and oligotrophic to eutrophic sites in the ICHb, ESSFb and ESSFc. This species is noticeably more abundant in disturbed areas.



ATHYRIUM FILIX-FEMINA (L.)Roth. Common Lady Fern

Features:
- rhizome densely covered with dark petiole-bases of previous years (a).
- fronds up to 2 m tall; leaf blades smooth, 2-3 times pinnate, lance-shaped, tapering both ways from middle; leaf stalks short, furrowed, straw-coloured, scaly at dark base.

Habitat and Range:
Occurs in all subzones except the IDFg and the PPBGc. Present on hygric and mesotrophic to eutrophic, generally floodplain sites in the IDFf, MSa, MSb, ESSFa and ESSFe. Also present on subhygric to subhydric and submesotrophic to eutrophic sites with mostly gleyed soils in the ICHa, ICHc, and ESSFc. In addition, it is present on submesic to hygric and submesotrophic to eutrophic sites in the ICHb and ESSFb. This species is often associated with *Oplopanax horridus* and *Gymnocarpium dryopteris*.



DRYOPTERIS ASSIMILIS Walker

(*Dryopteris austriaca* (Jacq.) Woynar)

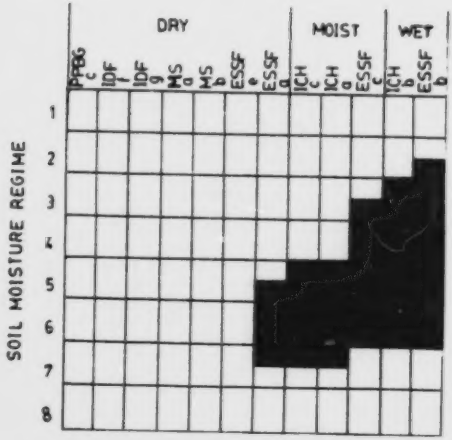
Spiny Shield Fern

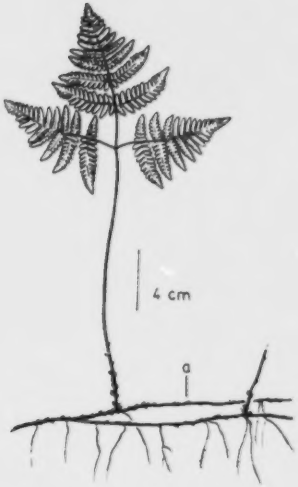
Features:

-fronds .3 - 1 m tall; leaf blades tripinnate, broadly triangular to egg-shaped or broadly oblong; basal leaflets broadly egg-shaped or triangular, inequilateral (a); leaf stalks shorter than blade, covered in brownish, often dark-centred scales.

Habitat and Range:

Present on a range of nutrient regimes in all subzones. Occurs on subhygric to subhydric sites in the ICHa, ICHc, and ESSFa, and on submesic to hygric sites in the ICHb, ESSFb and ESSFc. It is common on receiving positions and floodplains in the ICHa, ICHc and ESSFa and is usually associated with *Gymnocarpium dryopteris* and *Tiarella unifoliata* in all subzones. This species rarely occurs in the PPBGc, IDFf, IDFg, MSa, MSb and ESSFe.





GYMNOCARPIUM DRYOPTERIS (L.)Newm.

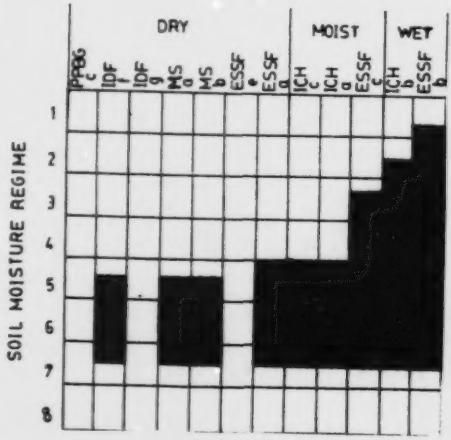
Oak Fern

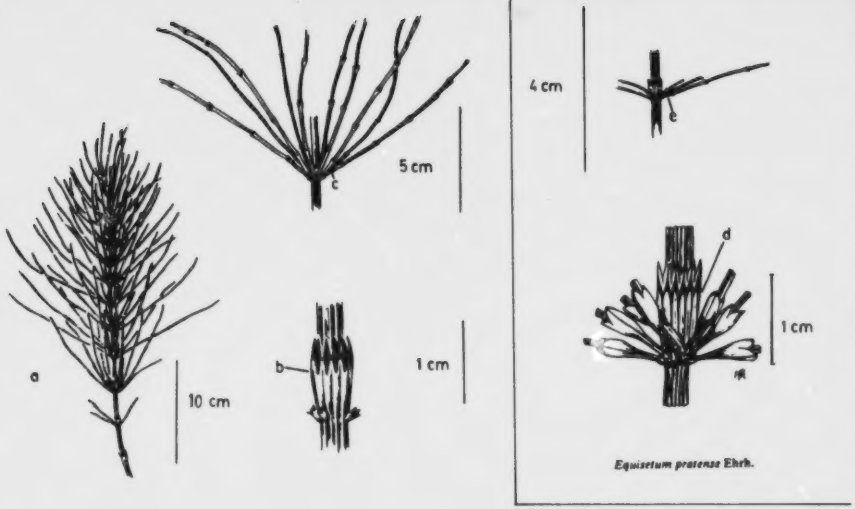
Features:

- fronds erect, up to 40 cm tall, arising singly from a widely creeping rhizome (a).
- leaf blades broadly triangular, basal leaflets triangular and almost equalling the rest of the frond in size; leaf stalks usually smooth, straw-coloured, arising from chaffy base and usually longer than blade.

Habitat and Range:

Occurs in all subzones except the PPBGc, IDFg and ESSFe. Present on subhygric to hygric and oligotrophic to eutrophic sites in the IDFf, MSa, MSb, ICHa, ICHc, and ESSFa on receiving sites, floodplains or wet depressions. It is also present in most ecosystems of the ICHb, ESSFb, and ESSFc. This species characteristically occurs in shaded forests.



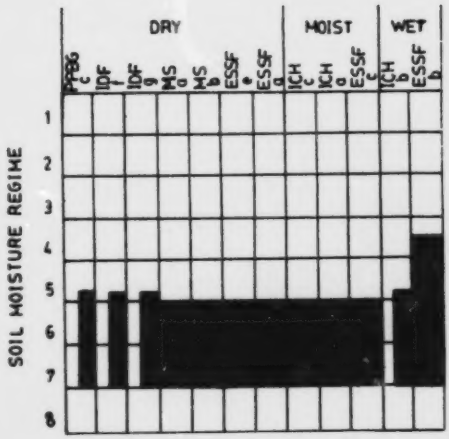


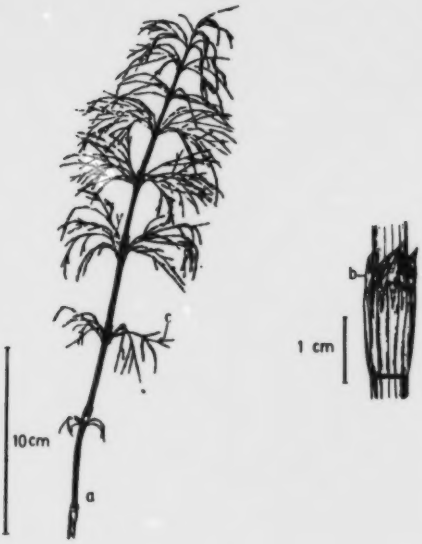
EQUISETUM ARVENSE L. — Common Horsetail

Features:
- sterile stems (a) green, annual, 10-12 ridged.
- sheaths (b) green, 5-10 mm long; triangular-lance-shaped teeth persistent, brown or blackish, as many as number of grooves.
- branches regularly whorled, 3-4 angled, unbranched.
- first internode of branches (c) longer than associated stem-sheath.

Note: *Equisetum pratense* Ehrh. (Meadow Horsetail) is sometimes mistaken for *Equisetum arvense* but can be distinguished by the following:
- stems 8-23 ridged.
- sheaths with dark-brown central stripe and clear margin (d).
- branches mostly 3-angled.
- first internode of branches (e) usually equalling or shorter than the associated stem-sheath.

Habitat and Range:
Common in all subzones on floodplains, and poorly drained, collecting or receiving sites. Present on subhygric to hygric and mesotrophic to eutrophic sites in the PPBGc, IDFf, IDFg, and ICHb; on hygric to subhydric and oligotrophic to eutrophic sites in the MSa, MSb, ICHa, ICHc, ESSFa, ESSFc and ESSFe; and on mesic to subhydric and oligotrophic to eutrophic sites in the ESSFb. This species commonly occurs with *Senecio triangularis* and *Calamagrostis canadensis*. Note: it may occur on drier disturbed sites.





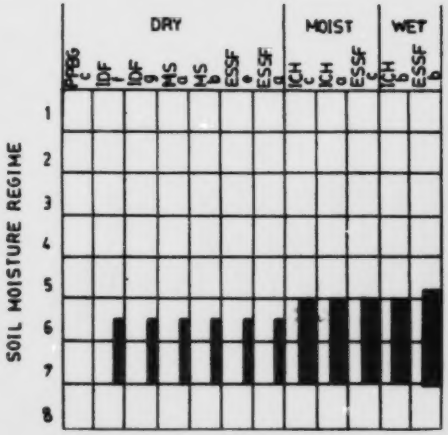
EQUISETUM SYLVATICUM L. Wood Horsetail

Features:

- sterile stems (a) with 2 rows of small, sharply-hooked spinules on each of 10-18 ridges.
- sheaths green at base, brown and papery above; teeth persistent, uniting into 3-5 lobes (b).
- branches deeply 4-5 angled, usually branched again (c); ultimate branches 3-angled with sheaths deeply 3-toothed.
- first internode longer than associated stem-sheath.

Habitat and Range:

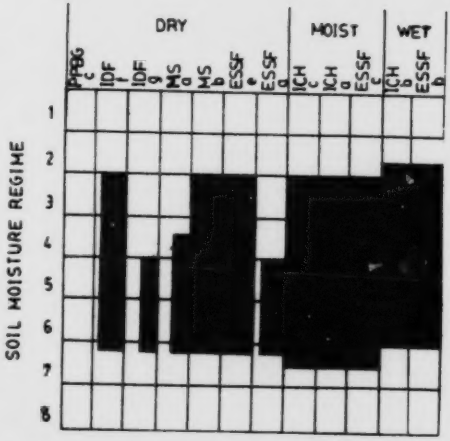
Occurs in all subzones except the PPBGc. Present on hygric to subhydric and mesotrophic to eutrophic sites on floodplains and collecting areas. It may be found on subhygric sites with rich, fine-textured, lacustrine materials. This species is often associated with *Equisetum arvense*.



SMILACINA RACEMOSA (L.)Desf. False Solomon's-Seal

Features:
- -strongly rhizomatous.
- -stems 0.5 - 1.0 m tall, finely hairy.
- -leaves stalkless and clasping (a), finely hairy, lance-shaped to elliptic.
- -flowers (b) white and numerous on freely branching, terminal, pyramidal inflorescence (c).
- -berries reddish.

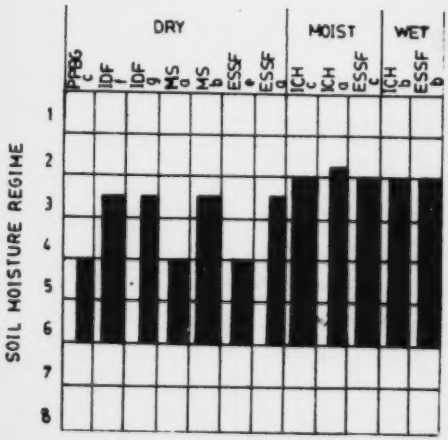
Habitat and Range:
Broadly occurring species in all subzones with the exception of the PPBGc where it is absent. It commonly occurs on subhygric to hygric and mesotrophic to eutrophic sites in the IDFg and ESSfa, and on submesic to hygric and oligotrophic to eutrophic sites in all other subzones.

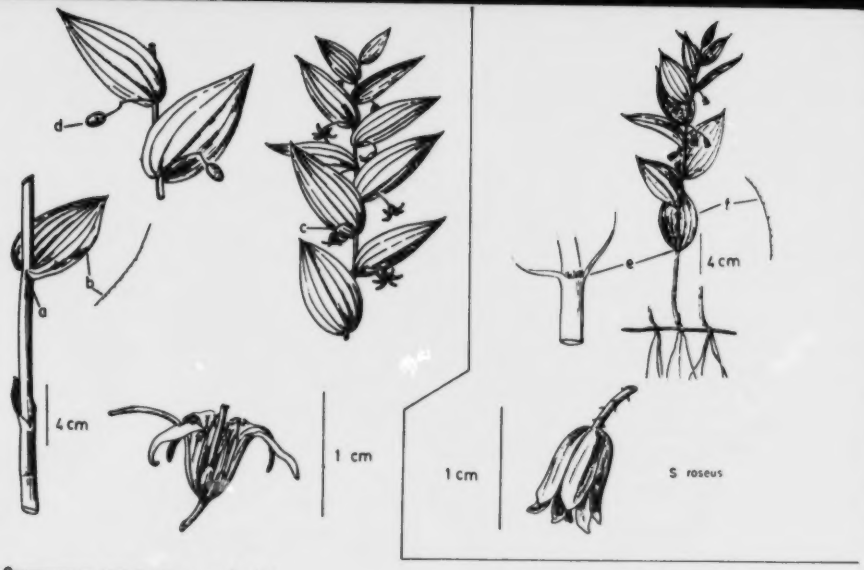


SMILACINA STELLATA (L.)Desf. Star-flowered False Solomon's-Seal

Features:
- rhizomatous.
- stems .2-.6 m tall.
- leaves stalkless, clasping, in two vertical rows, lance-shaped to oblong, prominently veined, minutely hairy beneath.
- inflorescence 5-10 flowered (a), flowers (b) white.
- berries (c) greenish-yellow with red stripes becoming dark blue.

Habitat and Range:
Present in all subzones where it most commonly occurs on floodplains, streambanks and imperfectly to poorly drained sites. It occurs on subhygric to hygric and mesotrophic to eutrophic sites in the PPBGc, MSa, and ESSFe, and on submesic to hygric and submesotrophic to eutrophic sites in all other subzones.



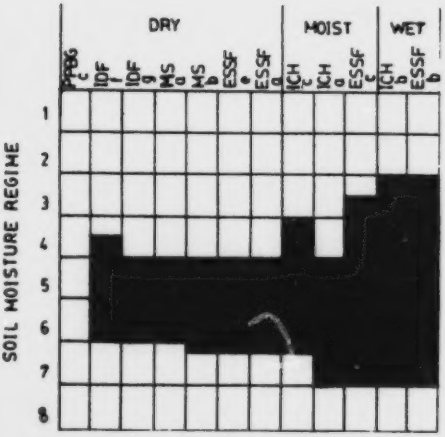


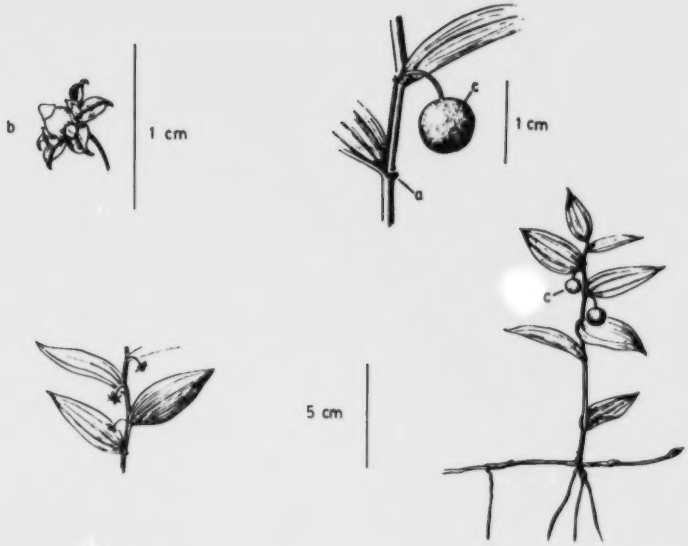
STREPTOPUS AMPLEXIFOLIUS (L.)DC. Cucumberroot Twistedstalk

Features:
- stems 5-10 dm tall, freely branched, not fringed at nodes (a).
- leaves alternate, egg-shaped to egg-shaped-lance-shaped, heart-shaped at base, clasping, whitish beneath, leaf margins with abundant cilia pointing in all directions (b).
- flower stalks 1-to 2-flowered, abruptly bent or twisted (c); flowers greenish-white, 9-15 mm long.
- berry (d) yellow to red.

Note: *Streptopus roseus* Michx. (Simple-stemmed Twistedstalk) may be separated from *S. amplexifolius* by the following:
- stems simple, sparsely fringed with hairs at nodes (e).
- leaves stalkless but not clasping, broadly rounded at base, not whitish beneath, leaf margins entire with less than 16 cilia/cm (f).
- flower stalks not bent or twisted; flowers rose-coloured, 6-10 mm long.

Habitat and Range:
Occurs in all subzones except the PPBGc. Present on subhygric to hygric and oligotrophic to eutrophic sites in the IDFg, MSa, MSb, ICHa, ESSFa and ESSFe where the sites characteristically have gleyed or organic soils. It also occurs on submesic to subhygric and oligotrophic to eutrophic sites in the IDFf, ICHb, ICHc, ESSFb and ESSFc where the soils are variable.





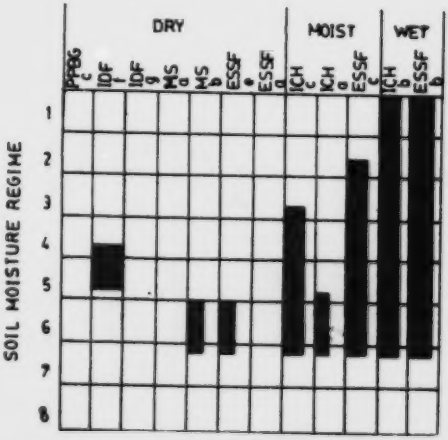
STREPTOPUS STREPTOPOIDES (Ledeb.)Frye & Rigg — Small Twistedstalk

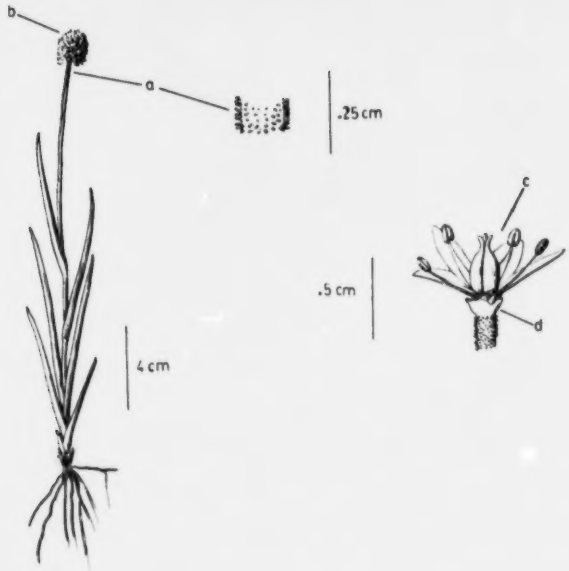
Features:

- stem simple, 1-2 dm tall, coarsely fringed with hairs at the nodes opposite the leaf blades (a).
- leaves egg-shaped-lance-shaped, rounded and slightly clasping at base, leaf margins with crowded minute teeth pointing forward (visible at 10X).
- flowers (b) single, rose-coloured, saucer-shaped; flower stalks curved backwards.
- berry (c) red.

Habitat and Range:

Occurs in all subzones with the exception of the PPBGc, IDFg, MSa, ESSFa and ESSFb. Present on hygric and oligotrophic to submesotrophic sites in the MSb, ICHa, and ESSFe; on mesic to subhygric and oligotrophic to eutrophic sites in the IDFf; and may be found on a wide range of sites (xeric to subhydric and oligotrophic to permesotrophic) in the ICHb, ICHc and ESSFc. This species is most common on acidic soils in coniferous forests.

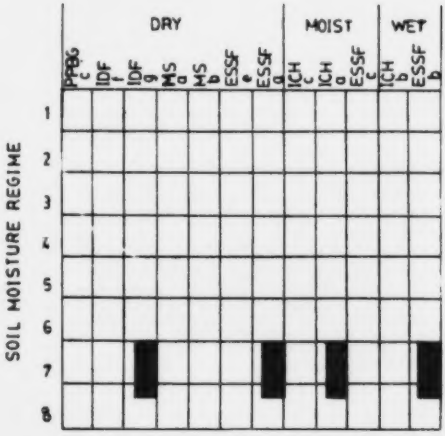


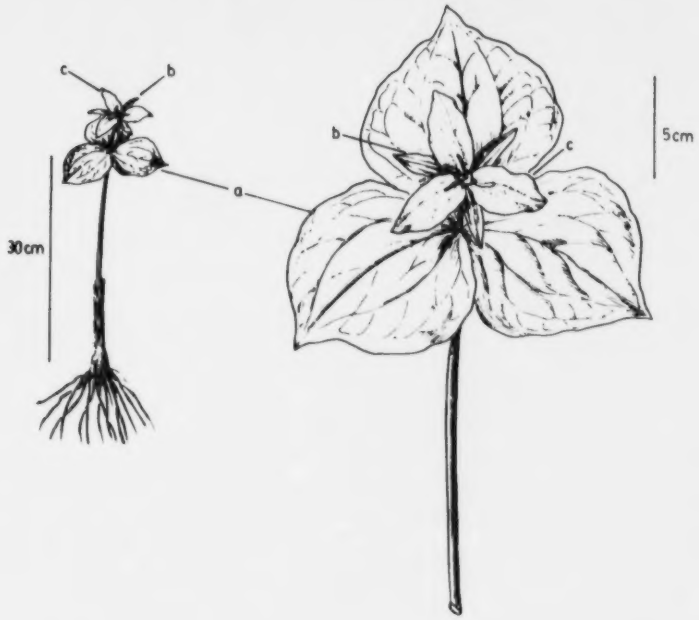


TOFIELDIA GLUTINOSA (Michx.)Pers. Sticky False Asphodel

Features:
- -stems 1 - 5 dm tall, densely glandular-hairy below inflorescence (a), sticky.
- -1 - 3 basal, sheathing, linear leaves to above midlength, often with single stem leaf.
- -inflorescence compact, terminal (b); flowers (c) white, 2 - 3 together at each node, each subtended by small bractlet (d).
- -fruit is a large purplish capsule.

Habitat and Range:
Restricted to the IDFg, ICHa, ESSFa and ESSFb where it occurs on subhydric and mesotrophic to eutrophic sites which are saturated year-round and are generally rich in calcium-carbonates. It is often associated with *Pinguicula vulgaris*.





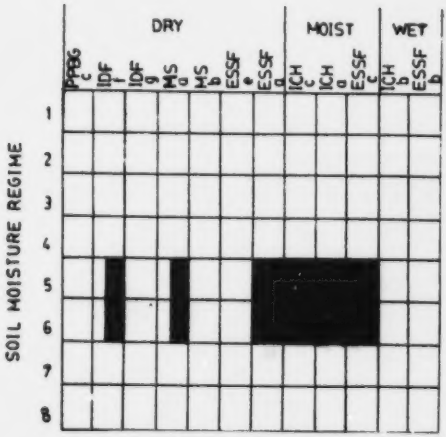
TRILLIUM OVATUM Pursh — Western White Trillium

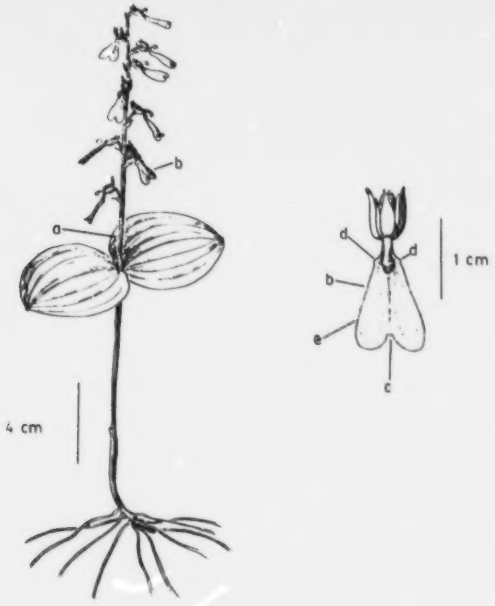
Features:

- stems annual.
- leaves stalkless, broadly egg-shaped to triangular-egg-shaped, somewhat rounded at base, in a whorl below flower (a).
- flower solitary, stalked; sepals (b) 3, green, petals (c) 3, white turning pink or purplish with age, longer and wider than sepals.

Habitat and Range:

Present on subhygric to hygric and oligotrophic to eutrophic sites, mostly on gleyed soils, in all subzones except the PPBGc, IDFg, MSb, ICHb, ESSFb and ESSFe where it is absent. This species is often associated with abundant decaying wood.

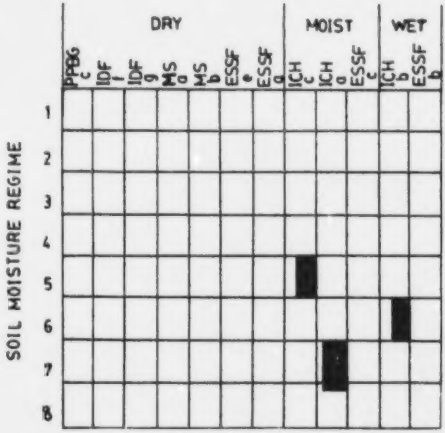


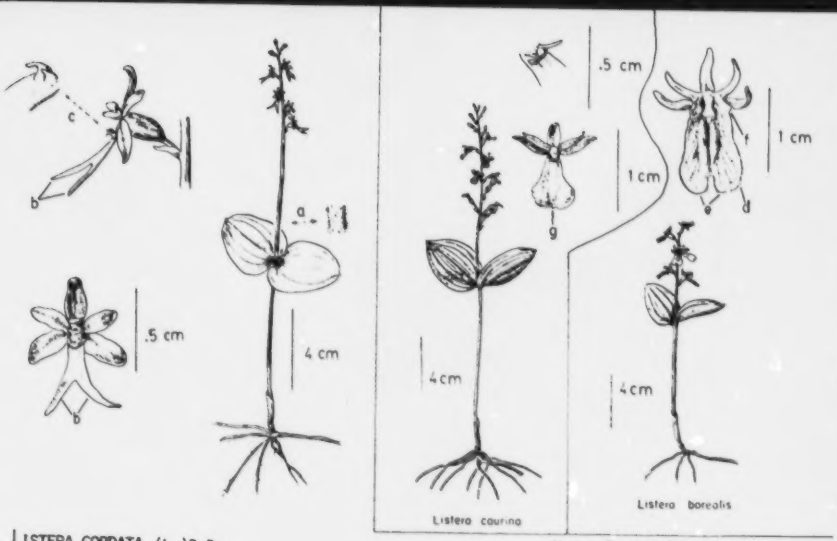


LISTERA CONVALLARIOIDES (Sw.)Nutt. Broad-leaved Twayblade

Features:
-stems smooth below leaves, glandular-hairy above (a).
-leaves 2, smooth, opposite, broadly oval, 3 - 6 cm long.
-inflorescence loosely many-flowered; flowers yellowish-green; lip wedge-shaped (b) with two lobes at the apex separated by a notch containing a small tooth (c), one tooth present on each side near the base (d), margin of lip fringed with hairs (e).

Habitat and Range:
Restricted to the ICHa, ICHb, and ICHc where it occurs on submesotrophic to eutrophic sites. Present on subhydric sites in the ICHa; on hygric sites in the ICHb; and on subhygric sites in the ICHc. This species is commonly associated with *Equisetum arvense* and *Lysichiton americanum*.





LISTERA CORDATA (L.)R.Br.

Heart-leaved Twayblade

Features:

- stem smooth except for small glandular-hairy area just above leaves (a).
- leaves two, opposite, stalkless, near middle of stem, broadly egg-shaped to heart-shaped.
- inflorescence terminal, few-flowered; flowers yellowish-green to purplish; lip deeply divided 1/2 - 3/5 the length into two narrowly spreading lobes (b), armed at base by two teeth (c).

Note: *Listera borealis* Morong (Northern Twayblade) differs from *Listera cordata* by the following features:

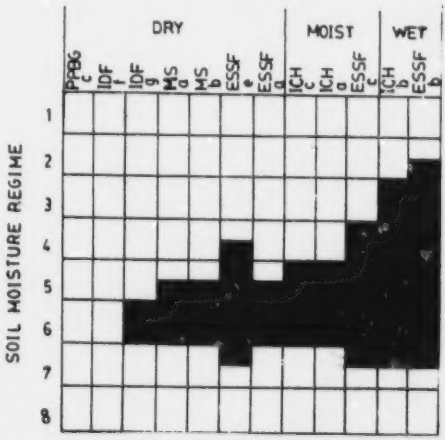
- stem 4-sided, smooth below leaves, hairy and glandular above.
- leaves lance-shaped or egg-shaped, rounded at leaf tip.
- lip of flower minutely hairy, at least along margins (d), shallowly bilobed (e), with broad ear-shaped appendages at base (f).

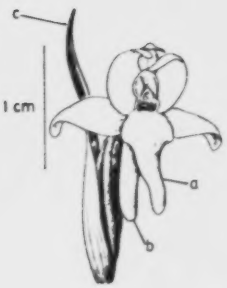
Note: *Listera caurina* Piper (Northwestern Twayblade) differs from *Listera cordata* by the following features:

- stem smooth below leaves, strongly glandular-hairy above.
- leaves egg-shaped with clasping base.
- lip of flower rounded to slightly notched at apex (g) with a small tooth on each side near the base, margin of lip smooth.

Habitat and Range:

Occurs in all subzones except the PPBGc and IDFf. Present on hygric and mesotrophic to eutrophic sites in the IDFg where it occurs with *Cornus sericea* and *Equisetum arvense*; on subhygric to hygric and submesotrophic to eutrophic sites in the MSa, MSb, ICHa, ICHc and ESSFa; on mesic to subhydric and oligotrophic to eutrophic sites in the ESSFc and ESSFe; and on submesic to subhydric and oligotrophic to eutrophic sites in the ICHb and ESSFb.





PLATANTHERA DILATATA (Pursh)Lindl. Fragrant White Rein Orchid

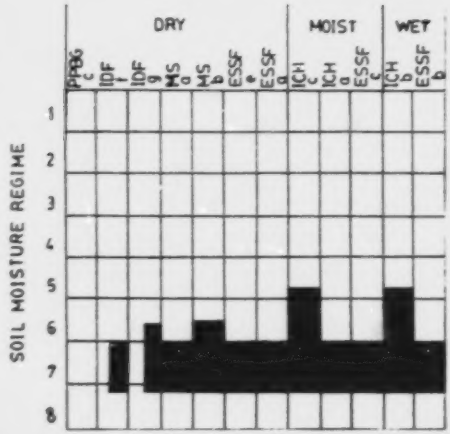
(*Habenaria dilatata* (Pursh.) Hook.)

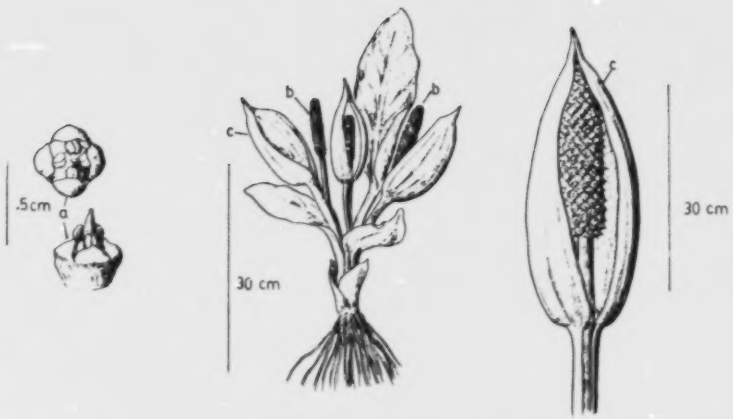
Features:

-stem up to 1 m tall, leafy.
-leaves lance-shaped, reduced upwards.
-flowers strongly spicy-fragrant, white or greenish-white; lip broadly lance-shaped (a), conspicuously widened at the base; spur (b) shorter than or equalling lip; floral bracts (c) lance-shaped and exceeding flowers.

Habitat and Range:

Occurs in all subzones except the PPBGc. Present on hygric to subhydric and oligotrophic to eutrophic sites in all subzones except the ICHb and ICHc where it occurs on subhygric to subhydric sites. This species is found primarily on gleyed and organic soils in fens, bogs, and sometimes in wet forests and is often associated with *Equisetum arvense*, *Senecio triangularis*, *Ledum groenlandicum*, *Sphagnum capillaceum* and *Carex aquatilis*.



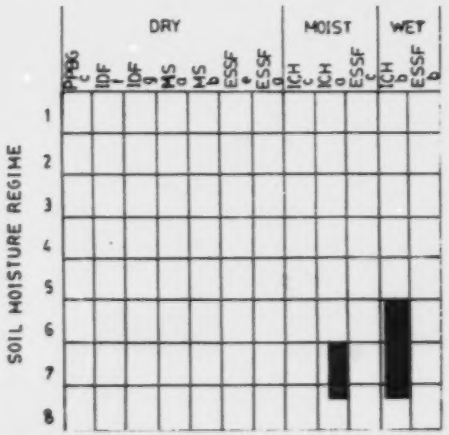


LYSICHITON AMERICANUM Hultén & St. John. American Skunk-Cabbage

Features:
- leaves all basal, lance-shaped to oblong-egg-shaped.
- flowers (a) minute, greenish-yellow, borne on a fleshy stalk (spadix) (b) surrounded by a yellow, leaflike sheath (spathe) (c).
- skunklike odour produced when leaves are bruised or crushed.

Habitat and Range

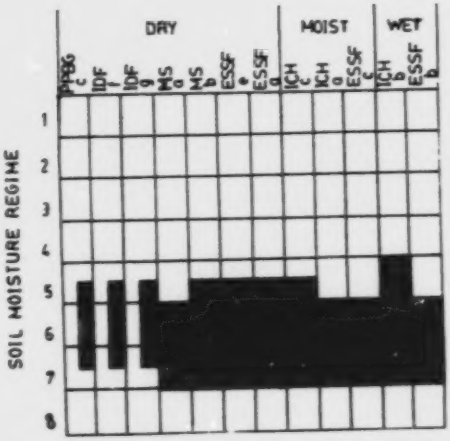
Restricted to the ICHa and ICHb subzones. Present on hygric to subhydric and submesotrophic to eutrophic sites in the ICHb where it occurs primarily on wet hillsides and in receiving or collecting areas. In addition, it is present on subhydric and mesotrophic to eutrophic sites in the ICHa where it occurs in depressions and collecting areas. Often occurs with *Equisetum arvense*.



CALAMAGROSTIS CANADENSIS (Michx.)Beauv. Bluejoint Small Reed Grass

Features:
- -perennial, tufted, strongly rhizomatous, 6 - 12 dm tall.
- -ligules membranous, 3 - 8 mm long, with torn margin on all but basal leaves where margin appears gnawed and hairy.
- -leaf blades flat, rough to touch, 4 - 8 mm wide.
- -inflorescence (a) open; spikelet a single floret; glumes (b) purplish; lemma (c) membranous and papery; awn arising just below middle back of lemma (d); hairs abundant on thickened base of lemma (callus) and between 3/4 to as long as lemma.

Habitat and Range:
Present throughout the Nelson Forest Region although most common in the ICHa, ICHb, ICHc, ESSFb and ESSFc. Occurs on subhygric to subhydric and oligotrophic to eutrophic sites with gleyed or organic soils. This species is generally found on floodplains and is often associated with *Equisetum arvense* and *Sphagnum capillaceum*.



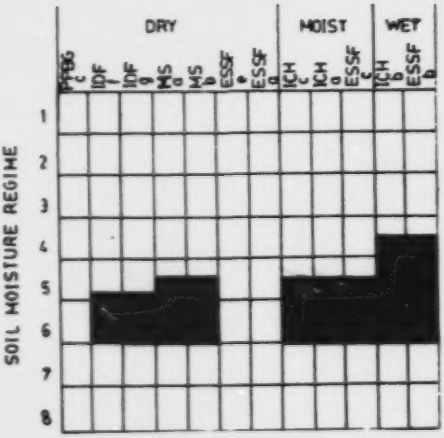
CINNA LATIFOLIA (Trevir.)Griseb.. Wood Reed Grass

Features:

- perennial, rhizomatous, 7-20 dm tall.
- ligules hairy, with torn margin, 3-8 mm long.
- leaf blades flat, 7-15 mm wide, rough to touch.
- inflorescence green, loose, branches spreading to drooping; spikelets (a) 1-flowered; glumes (b) 1-nerved, the second slightly longer; lemma 3-nerved; if awn present then less than or equal to 1 mm.

Habitat and Range:

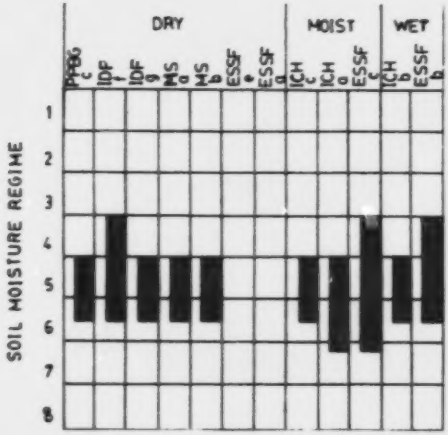
Occurs in all subzones except the PPBGc, ESSFa, and ESSFe. Present on a wide range of nutrient regimes and often found on fluvial and lacustrine soils. It occurs on subhygric to hygric sites in all subzones except in the ICHb and ESSFb where it occurs on mesic to hygric sites. This species is generally associated with *Equisetum arvense* and *Athyrium filix-femina*.

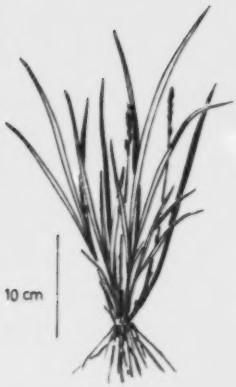


ELYMUS GLAUCUS Buckl. Blue Wild Rye Grass

Features:
-tufted perennial; aerial stems leafy, 5 - 10 dm tall.
-auricles present; ligules 1 mm long.
-collar purple.
-leaf blades flat, 5 - 10 mm broad, rough to touch on both sides.
-spikelets (a) sessile, 2 per node and overlapping, florets 3 - 5; glumes about equalling spikelet, strongly 3- to 5-nerved, sharp-pointed to short-awned; lemmas awned; the awn (b) 1 to 2 times as long as the body of the lemma, 1 - 2 cm long.

Habitat and Range:
Present in all subzones of the Nelson Forest Region except in the ESSFa and ESSFe. Occurs on sites with mesotrophic to eutrophic nutrient regimes and is usually found on rich floodplains, temporary creek channels and rich, fine-textured soils. Present on subhygric to hygric sites in all subzones except the IDFf, ESSFb and ESSFc where it occurs on mesic to hygric sites.





ORYZOPSIS ASPERIFOLIA Michx.

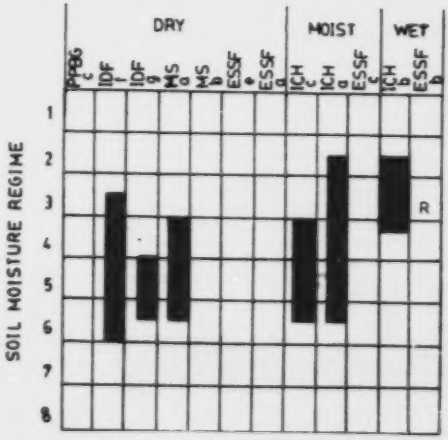
Rough-leaved Rice Grass

Features:

- tufted perennial.
- aerial stems 2-5 dm tall.
- leaf blades of aerial stems greatly reduced or lacking, those of offsets are erect, flat, very rough to touch, tapering strongly at each end, paler beneath.
- inflorescence few-flowered, 4-8 cm long; glumes (a) 7-nerved, irregularly margined, abruptly narrowed to sharp-pointed tip; lemma (b) equalling glumes, strongly crisp-hairy on upper part of thickened base of lemma (callus); awn (c) 5 to 10 mm long.

Habitat and Range:

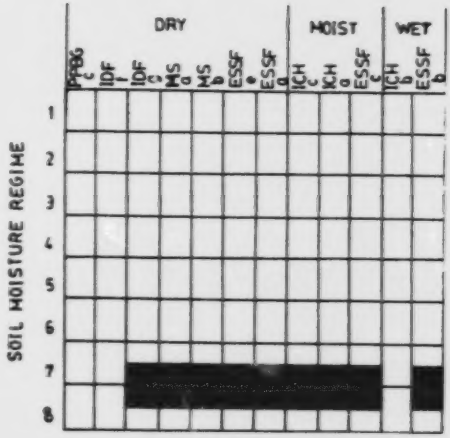
Common on fine-textured soils and floodplains in all subzones except the PPBGc, MSb, ESSFa, ESSFb, ESSFc, and ESSFe where it is either rare or absent. Present on subhygric to hygric and mesotrophic to eutrophic sites in the IDFg, and on submesic to hygric and submesotrophic to eutrophic sites in the IDFf, MSa, ICHa, ICHb and ICHc.

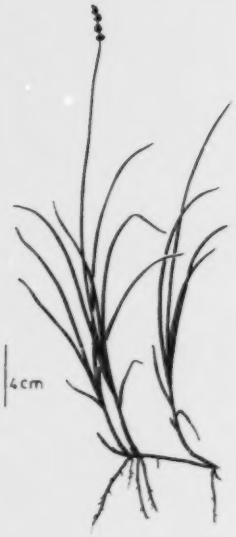


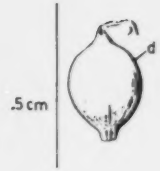
CAREX AQUATILIS Wahl. Water Sedge

Features:
- -rhizomatous, densely tufted.
- -stems 3 - 10 dm tall, triangular, reddish-tinged at base.
- -leaves flat, 2 - 7 mm wide.
- -spikes 3 - 7 per plant, terminal 1 - 3 spikes staminate (a), the other 2 - 6 pistillate (b); bracts subtending inflorescences sheathless, lowest bract elongate and leafy (c); pistillate scales reddish-brown with paler midrib, narrower than the perigynia; perigynia (d) elliptic to oval, strongly flattened, nerveless except for well-developed marginal nerves; stigmas 2.
- -achenes shaped like double-convex lens (lenticular).

Habitat and Range:
Present on subhydric to hydric and oligotrophic to eutrophic sites in all subzones except the PPBGc, IDFf, and ICHb where it is either rare or absent. It primarily occurs on organic soils in fens, bogs or shallow standing water.







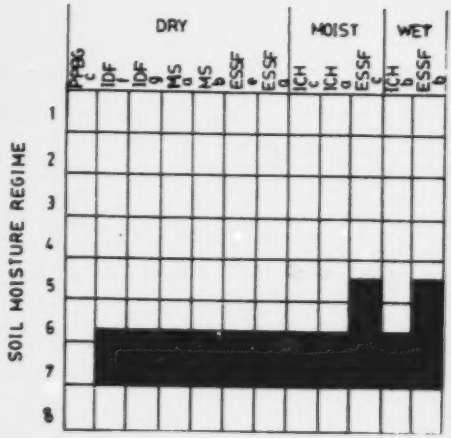
CAREX DISPERMA Dewey — Soft-leaved Sedge

Features:

- plants loosely tufted, appearing grasslike.
- rhizomatous, stems 1-4 dm tall, lowest leaves reduced to scales.
- leaves flat, 1-2 mm wide, all borne on lower part of stem.
- spikes 2-4, stalkless, in an interrupted-linear inflorescence (a), only uppermost ones touching; all spikes with both staminate and pistillate flowers, the staminate (b) above the pistillate (c); pistillate scales straw-coloured, thin and chaffy, equalling or shorter than perigynia; perigynia (d) 1-3, 2-3 mm long, elliptic, many-nerved, abruptly contracted to a short, obliquely cleft beak; stigmas 2.
- achenes shaped like double-convex lens.

Habitat and Range:

Common in all subzones except the PPBGc where it is absent. Present on sites with oligotrophic to eutrophic nutrient regimes. It occurs on hygric to subhydric sites in all subzones except the ESSFb and ESSFc where the sites are subhygric to subhydric. This species commonly occurs with *Equisetum arvense* and is usually associated with water at the surface at least during early summer.



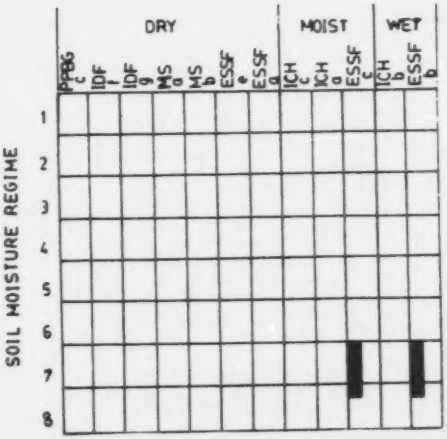
CAREX LIMOSA L. Shore Sedge

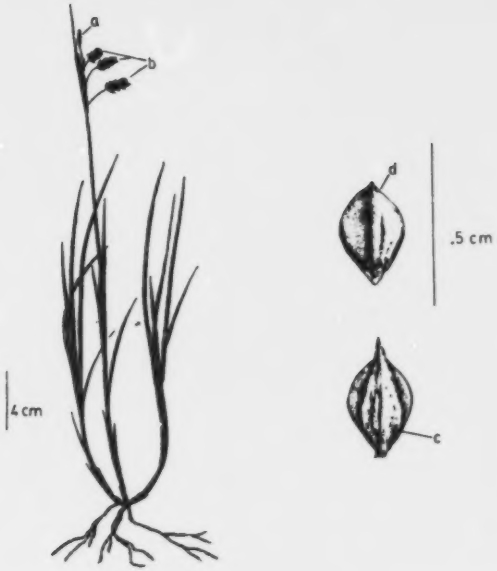
Features:

- -scarcely tufted, 2 - 6 dm tall, lower leaves strongly reduced to scales (a).
- -roots covered in yellowish-brown woolly hairs (b).
- -leaves few, 1 - 2 mm wide, deeply channelled.
- -staminate spike (c) solitary and terminal; pistillate spikes (d) 1 - 3, lowest one subtended by a leafy bract 2 - 10 cm long; pistillate scales about equal in size to perigynia; perigynia (e) densely papillate, with prominent marginal nerves plus 4 - 7 nerves on each face; stigmas 3.
- -achenes 3-angled.

Habitat and Range:

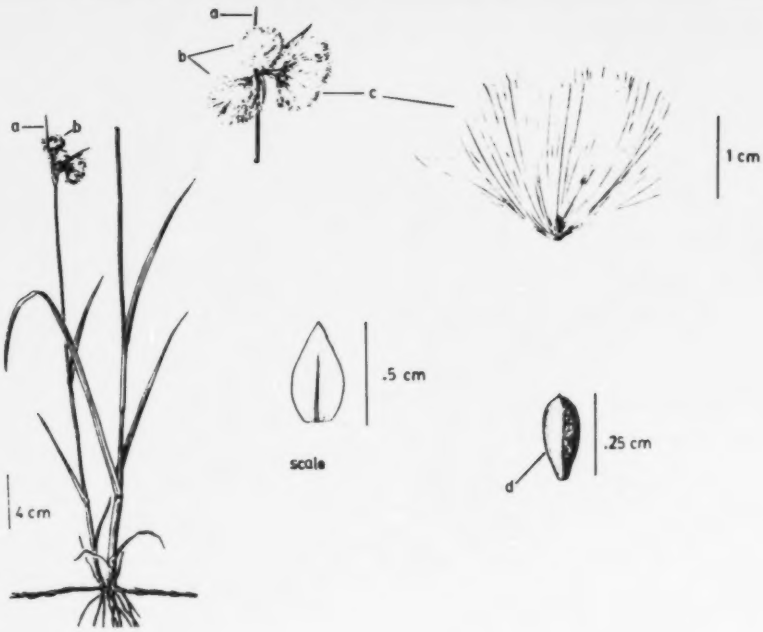
This species has only been collected and recorded in the ESSFb and ESSFc. However, other sources suggest that it may be found in all other subzones. It occurs on subhydric and oligotrophic to submesotrophic bogs and fens and is usually associated with *Sphagnum capillaceum* and *Salix planifolia*.





Note: *Carex paupercula* Michx.(Poor Sedge) is similar to *C. limosa* but can be separated from it by the following features:

- stem 1.5-7 dm tall, loosely clustered in small tufts, lower leaves well-developed, remains of old leaves persistent around base.
- leaves 1-3 mm wide.
- staminate spike (a) terminal, solitary; pistillate spikes (b) 1-4; pistillate scales (c) with green midstripe; perigynia (d) densely papillate, pale, with prominent marginal nerves and 3-6 nerves on each face.



ERIOPHORUM ANGUSTIFOLIUM Honck. Narrow-leaved Cotton-grass

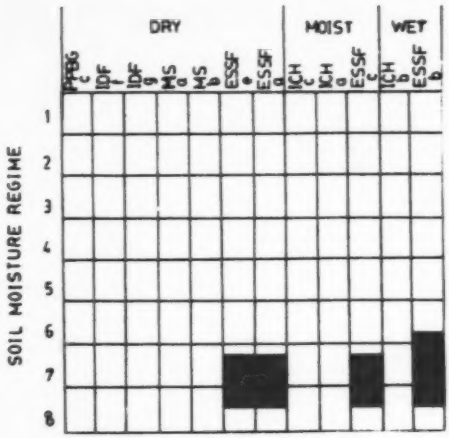
(*Eriophorum polystachion* L.)

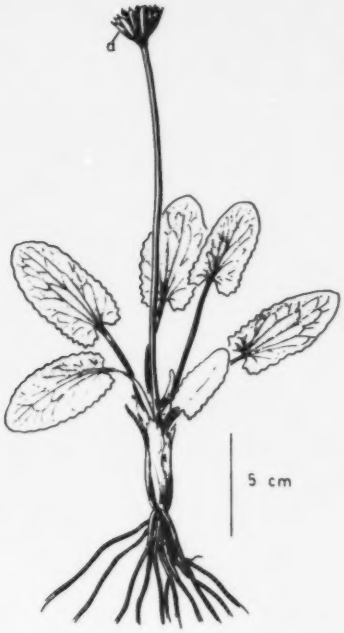
Features:

- -rhizomatous, extensively colonial.
- -aerial stems 2 - 6 dm tall, bluntly angled.
- -leaves 2 - 6 mm wide, flat becoming triangular and channelled toward the tip, margin rough to touch.
- -bracts below inflorescence several, unequal, two or more of them leafy above papery base, longest one surpassing inflorescence (a).
- -spikelets (b) 2 - 8; scales dark with thin, clear margins, midrib not reaching the tip; florets with numerous, white bristles (c).
- -achenes (d) blackish.

Habitat and Range:

Restricted to the ESSF subzones where it occurs on hygric to subhydric and oligotrophic to eutrophic bogs or wet, herbaceous meadows. It is usually found on organic or gleyed soils.





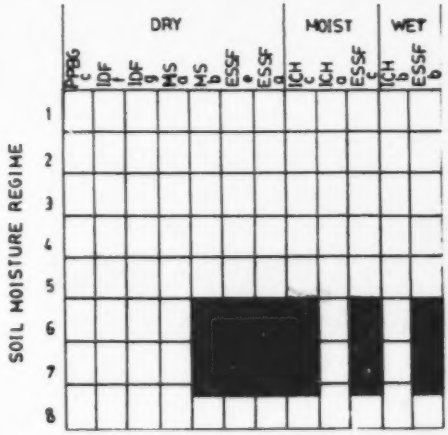
CALTHA LEPTOSEPALA DC. Alpine White Marsh-Marigold

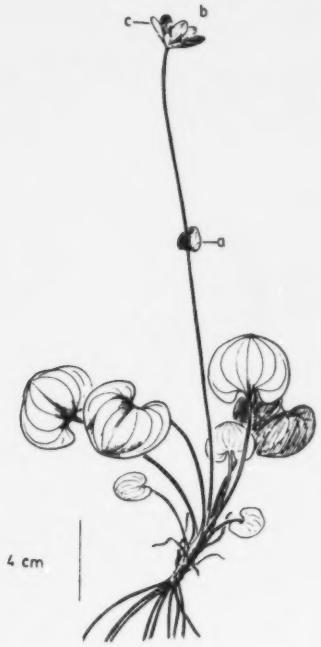
Features:

- flowering stems solitary, erect, leafless or bearing a single leaf.
- basal leaves several, leaf blades oblong-oval, heart-shaped at base, up to 6 cm long, margin toothed.
- flowers 1 or 2; sepals 6 or more, oblong, white or tinged blue on outside; petals absent.
- fruit (a) about 15 mm long, beak almost 1 mm.

Habitat and Range:

Primarily found in the ESSF subzones on hygric to subhydric and oligotrophic to eutrophic bogs and wet meadows but may also be found in the MSb and ICHc. This species often occurs with *Equisetum arvense* and *Sphagnum capillacem*.





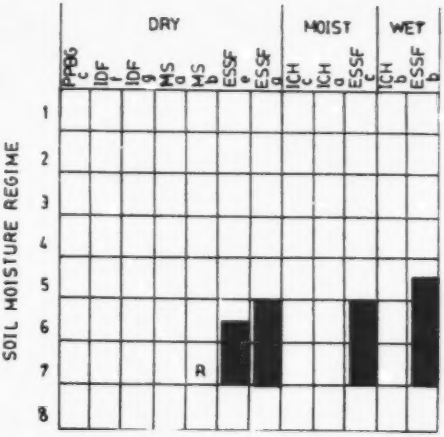
PARNASSIA FIMBRIATA Konig. Fringed Grass-of-Parnassus

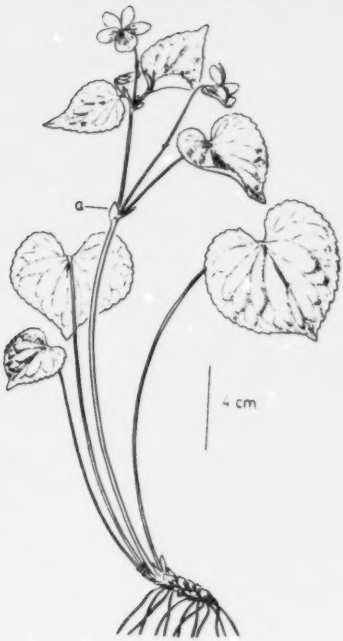
Features:

-flower stems 1 - several, 1.5 - 3 dm tall, with a single, heart-shaped, clasping bract (a) borne halfway or higher on stem.
-leaf stems 3 - 10 cm long, leaf blades kidney-shaped or broadly heart-shaped.
-flower (b) solitary; petals (c) white, 5 - 7 veined, with threadlike fringe at the base (d).

Habitat and Range:

Occurs primarily in the ESSF subzones on hygric to subhydric and submesotrophic to eutrophic sites but may also occur as dry as subhygric in the ESSFb. This species is generally associated with *Trollius laxus* and *Equisetum arvense*.





VIOLA GLABELLA Nutt.

Yellow Wood Violet

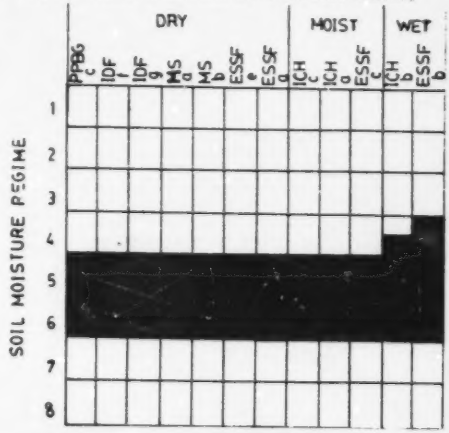
Features;

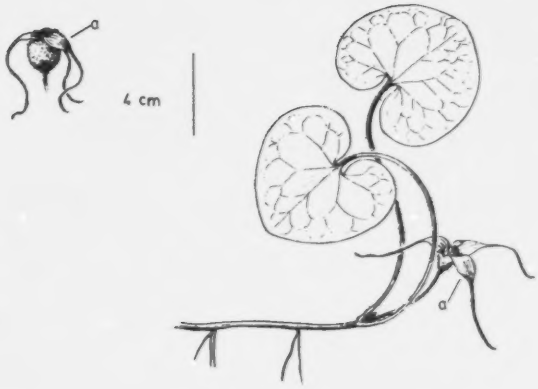
- flowering stems 5-30 cm tall, leafless except on upper 1/3 - 1/5 of length.
- stipules (a) egg-shaped, entire, membranous, 5-10 mm long.
- leaf blades kidney-shaped to egg-shaped-heart-shaped, abruptly sharp-pointed, margin round-toothed.
- flowers 8-14 mm long, borne mainly on upper part of stem on flower stems (peduncles) as long as leaves; spur very short; petals yellow on both surfaces, 3 lower ones purplish-pencilled within, lateral pair well bearded.

Note: *Viola canadensis* L. (Canada Violet) is easily confused with *Viola glabella* but may be separated from it by the following features:

- stipules lance-shaped, 1 - 2 cm long.
- leaf blades kidney-shaped to oval, mostly somewhat heart-shaped-kidney-shaped.
- flowers about 15 mm long, mainly white, on flower stems shorter than leaf stalks; petals generally shaded with some yellow, at least basally, lateral petals not violet-spotted.

Habitat and Range:
Present in all subzones on a wide range of nutrient regimes on floodplains and moist hillsides. Occurs on subhygric to hygric sites in all subzones except the ICHb and ESSFb where it occurs on mesic to hygric sites. This species is often associated with *Gymnocarpium dryopteris* and *Cornus sericea*.





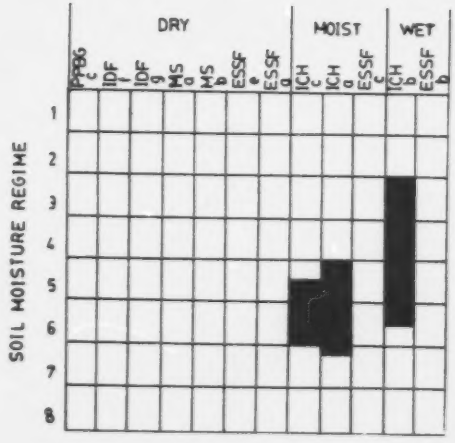
ASARUM CAUDATUM Lindl. Western Wild Ginger

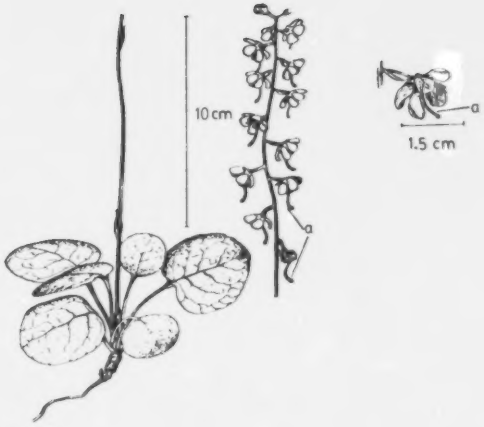
Features:

-trailing herb.
-leaves two per node, persistent, glossy, heart-shaped, palmately veined, have a distinctive ginger-like smell when crushed.
-flowers borne close to the ground; sepals (a) 3, deep red to brown, tapering to long tail, each sepal with 2 round, light areas on inner surface; petals absent; stamens 12; flowers have faint odour of ginger.

Habitat and Range:

Restricted to the ICH subzones and present on subhygric to hygric and oligotrophic to eutrophic sites in the ICHa and ICHc, and on submesic to hygric sites in the ICHb. This species is often found on flood-plains in the ICHa and ICHc but occurs on a broad range of materials in the ICHb.





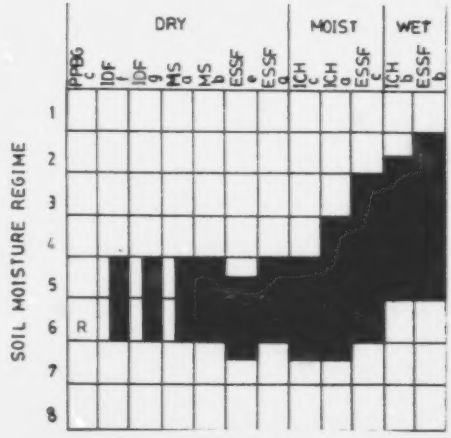
PYROLA ASARIFOLIA Michx. Common Pink Pyrola

Features:

- stems 1.5 - 4 dm tall, with numerous basal leaves.
- leaf blades nearly round to elliptic or obovate, leathery, 3-8 mm long, dark green and shining on upper surface, somewhat purplish beneath, round-toothed, petioles purplish.
- inflorescences elongate, 10-25 flowered; petals pinkish to rose or purplish-red; style (a) 5-8 mm long, strongly curved.

Habitat and Range:

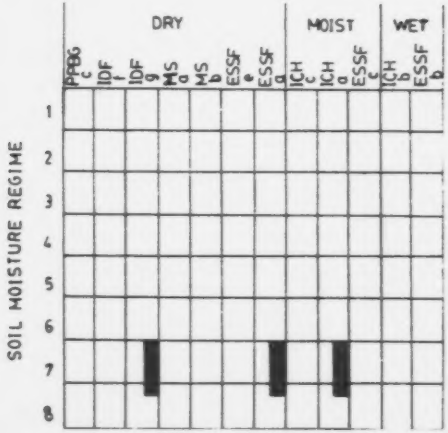
Common in all subzones where it occurs on subhygric to hygric and oligotrophic to eutrophic sites in the PPBGc, IDFf, IDFg, MSa, MSb, ICHc, ESSFa and ESSFe, and on a very broad range of sites in the ICHa, ICHb, ESSFb and ESSFc. This species is generally associated with *Cornus canadensis*.



PINGUICULA VULGARIS L. Common Butterwort

Features:
- -leaves 2 - 5 cm long, basal, yellowish-green, succulent, broadly oblanceolate or somewhat elliptic, with short leaf stems, slimy on upper surface.
- -flower stems leafless, 5 - 15 cm high.
- -flowers (a) lavender-purple or rarely white.
- -plants insectivorous, capturing insects on slimy leaf surface.

Habitat and Range:
This species is known to occur only in the IDFg, ICHa, and ESSFa. It is present on subhydric and eutrophic sites on highly calcareous, saturated soils on hillsides and in depressions.

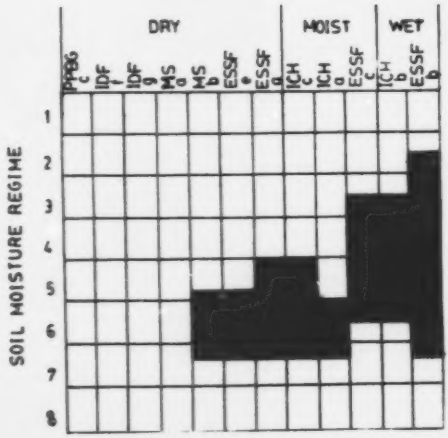


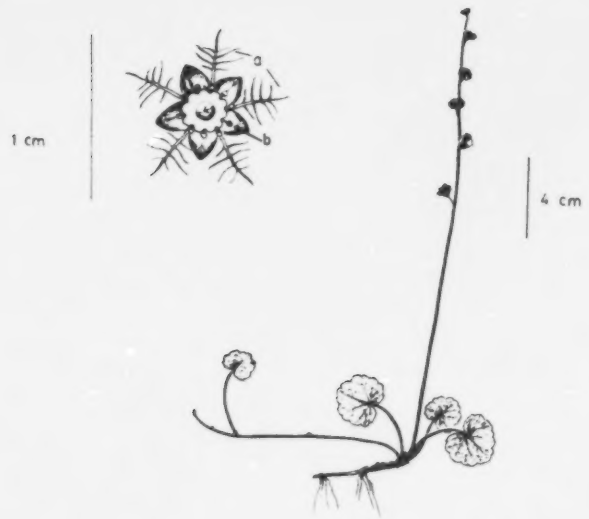
MITELLA BREWERI Gray — Brewer's Mitrewort

Features:

- stems leafless, 1.5 - 3 dm tall, smooth or sparsely hairy below becoming densely glandular-hairy in the inflorescence.
- leaves basal; leaf blades heart-shaped to kidney-shaped, very shallowly 7- to 11-lobed, round toothed, 4-8 cm broad.
- inflorescence 20- to 60-flowered; flowers greenish-yellow; calyx broadly saucer-shaped; petals (a) pinnately divided into 5-9 threadlike segments; stamens (b) 5, alternate with petals.

Habitat and Range:
Present in all subzones except the PPBGc, IDFf, IDFg, and MSa. Occurs on a wide range of nutrient regimes and is present on subhygric to subhydric sites in the MSb, ICHa, ICHc, ESSFa and ESSFe, and on submesic to subhydric sites in the ICHb, ESSFb and ESSFc.





MITELLA NUDA L.

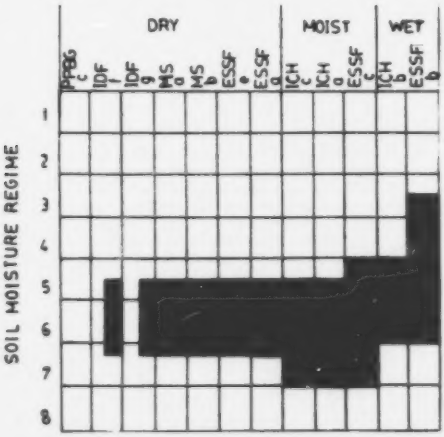
Common Mitrewort

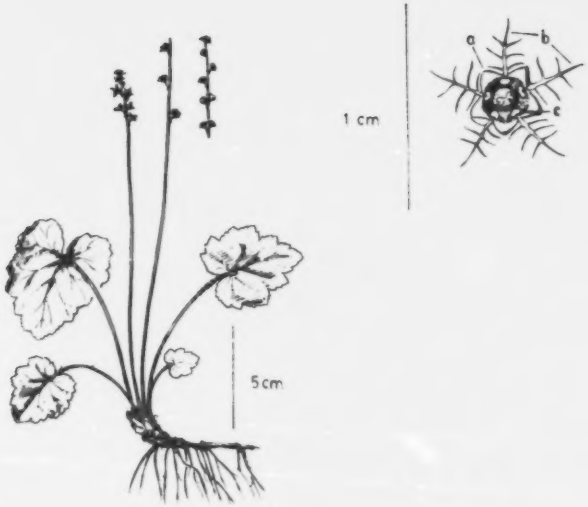
Features:

-stems .3 - 2 dm tall, finely glandular-hairy, leafless or with a reduced stalkless leaf near the base.
-leaves all basal; leaf blades heart-shaped to kidney-shaped, doubly round-toothed, sparsely hairy on upper surface.
-inflorescence 3- to 12-flowered, glandular-hairy; calyx broadly bell-saucer-shaped, lobed at least 1/2 the length; petals (a) 5, greenish-yellow, dissected into 8 threadlike, lateral divisions; stamens (b) 10.

Habitat and Range:

Occurs in all subzones except the PPBGc. It is present on a wide range of nutrient regimes and occurs on subhygric to hygric sites in all subzones except the ESSFb where it occurs on submesic to hygric sites. This species is often associated with *Cornus sericea*, *Athyrium filix-femina* and *Oplopanax horridus*.

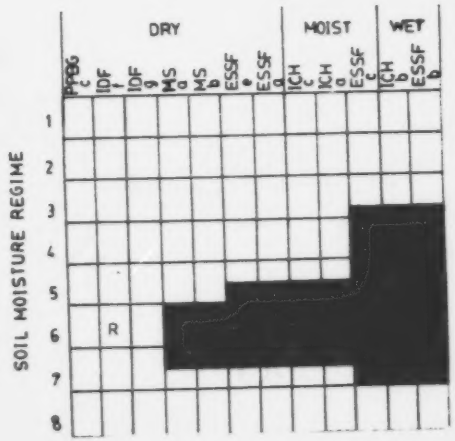


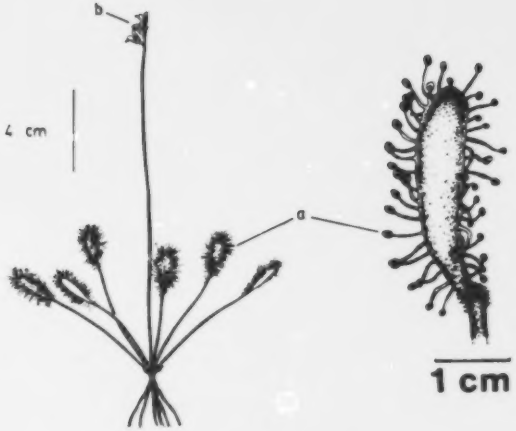


MITELLA PENTANDRA Hook. Five-stamened Mitrewort

Features:
- stems 2-3 dm tall.
- leaf blades oval-heart-shaped, shallowly 5- to 9-lobed, doubly round-toothed.
- inflorescence 6-20 flowered; calyx lobes triangular (a); petals (b) 5, greenish, dissected into 8 threadlike, lateral segments; stamens (c) 5, opposite petals.

Habitat and Range:
Present in all subzones except the PPBGc and IDFg and occurs on a wide range of nutrient regimes. It occurs generally with *Equisetum arvense* on hygric to subhydric sites in the IDFf, MSa and MSb; on subhygric to subhydric sites in the ICHa, ICHc, ESSFa and ESSFe; and on mesic to subhydric sites in the ICHb, ESSFb and ESSFc.



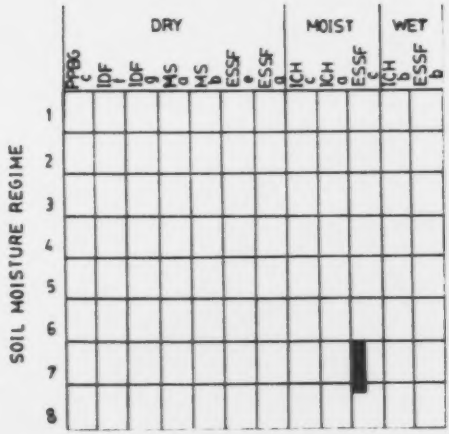


DROSERA ANGLICA Huds. Great Sundew

Features:

- -stems 6 - 18 cm tall, leafless.
- -basal leaves ascending to erect; leaf blades twice as long as broad, narrowly oblong-lance-shaped to elongate-spatula-shaped, densely glandular and fringed with long, reddish, glandular hairs (a) used for capturing and digesting insects.
- -inflorescence (b) 1-sided, 2- to 7-flowered, flowers white.
- -seeds spindle-shaped.

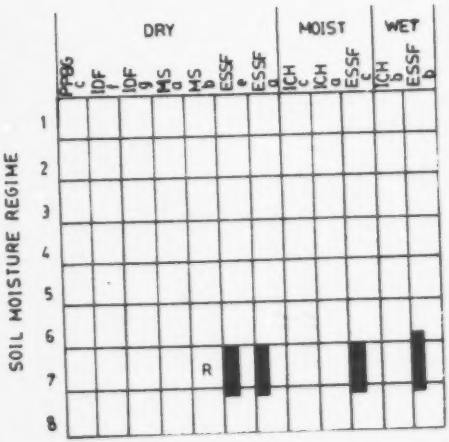
Habitat and Range:
This species is known only from the ESSFc and is found on subhydric and oligotrophic to submesotrophic bogs. It is often found with *Sphagnum capillaceum* in bogs.

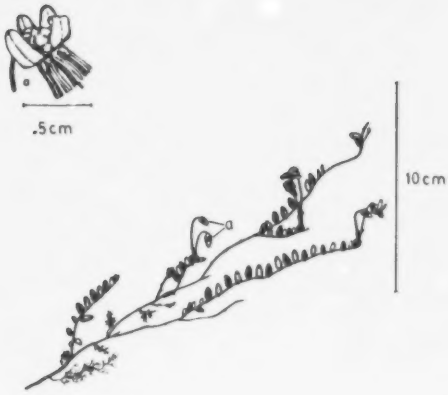


KALMIA MICROPHYLLA ssp. microphylla (Hook.)Heller — Western Swamp Kalmia
(*Kalmia polifolia* var. *microphylla* Rehd.)

Features:
- up to 1 dm tall, branched.
- leaves opposite, dark green, smooth above, whitish and very finely and densely granular-hairy beneath, non-toothed, leaf margins rolled under (a), leaf blades oblong-lance-shaped to narrowly oblong, 1-2 cm long.
- flowers (b) deep pinkish-rose, less than 12 mm broad.

Habitat and Range:
This species is known only from the MSb and the subzones of the ESSf. It occurs on hygric to subhydric and oligotrophic to mesotrophic bogs and is generally associated with *Sphagnum capillaceum* and *Platanthera dilatata*.

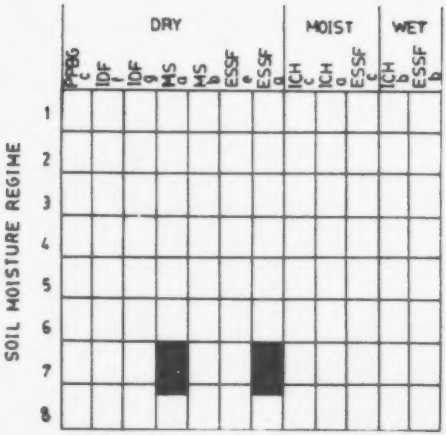


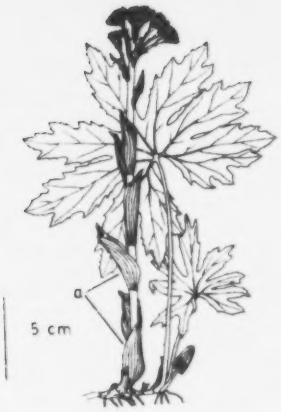


VACCINIUM OXYCOCCOS L. Bog Cranberry

Features:
- -creeping herb, branches short.
- -leaves persistent, alternate, leathery, egg-shaped to elliptic-oblong, sharp-pointed, 2 - 6 mm long, deep green and shining above, whitish beneath, margins rolled under, almost stemless.
- -flowers (a) solitary or in clusters up to 3, terminal or lateral on stems, deep pinkish.
- -berries pale pink to red.

Habitat and Range:
This species is known only from the MSa and ESSFa where it is found on subhydric and oligotrophic to eutrophic *Sphagnum* bogs.

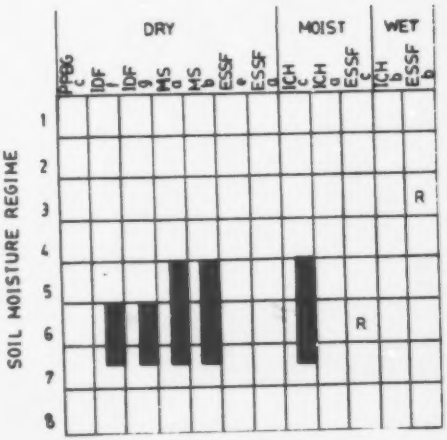




PETASITES PALMATUS (Aiton)Gray — Palmate Colt's-Foot
(*Petasites frigidus* var. *palmatus* (Ait.) Cronq.)

Features:
- rhizomatous.
- basal leaves kidney-shaped to nearly circular, palmately lobed and veined, lobes extending over half way to base, green above, white, woolly hairy beneath, toothed.
- flower stem erect, 1-5 dm tall, parallel-veined bracts (a) 2.5-6 cm long; flower heads with white, sweet-scented flowers.

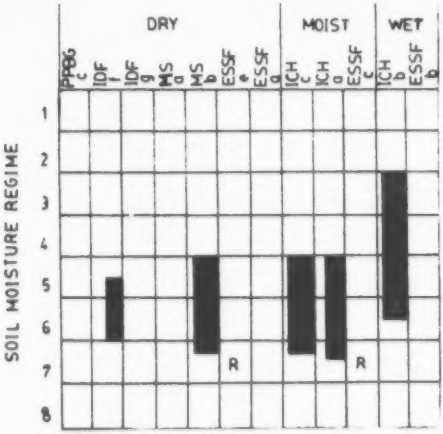
Habitat and Range:
This species is not known to occur in the PPBGc, ICHa, ICHb, ESSFa, and ESSFe, and is rare in the ESSFb and ESSFc. It occurs on hygric and mesotrophic to eutrophic sites with *Cornus sericea* and *Equisetum arvense* in the IDFf and IDFg, and on subhygric to hygric sites in the MSa, MSb, and ICHc.



ADENOCAULON BICOLOR Hook. Trailplant

Features:
- -stems to nearly 1 m tall, glandular above.
- -leaves mostly near the base, alternate; leaf blades large, triangular-egg-shaped to heart-shaped, smooth and dark green above, white woolly hairy beneath, leaf margin coarsely toothed or shallowly lobed.
- -flowers (a) small, white.

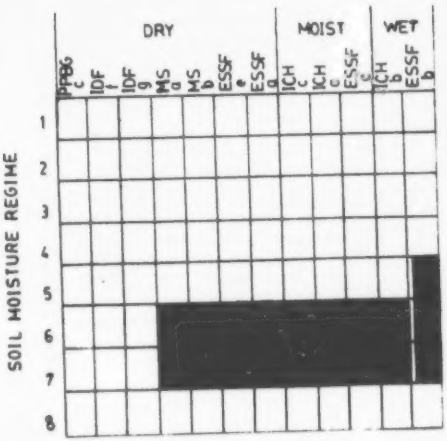
Habitat and Range:
This species is absent or rare in the PPBGc, IDFg, MSa and all subzones of the ESSF. It is present on submesotrophic to eutrophic nutrient regimes and occurs on subhygric to subhydric sites in the IDFf, MSb, ICHa, and ICHc, and on submesic to hygric sites in the ICHb.

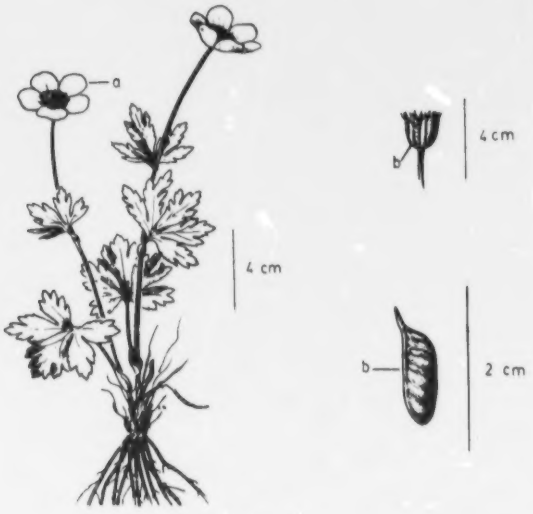


SENECIO TRIANGULARIS Hook. Arrow-Leaved Ragwort

Features:
- stems several, leafy, 3-15 dm tall.
- leaves numerous, lower stem leaves triangular to triangular-heart-shaped, with long leaf stems, upper stem leaves lance-shaped with shorter leaf stems or becoming stalkless; leaf blades strongly toothed.
- flower heads in an open, flat-t ped inflorescence, flowers yellow.

Habitat and Range:
Commonly occurs on oligotrophic to eutrophic sites in all subzones except the PPBGc, IDFf, and IDFg where it is absent. It is present on hygric to subhydric sites in all subzones except the ESSFb where it occurs on subhygric to subhydric sites. This species is usually associated with *Equisetum arvense*.

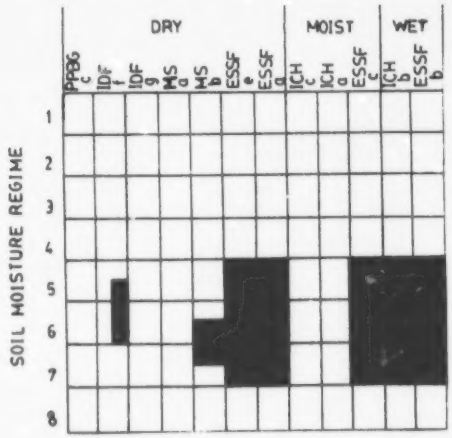


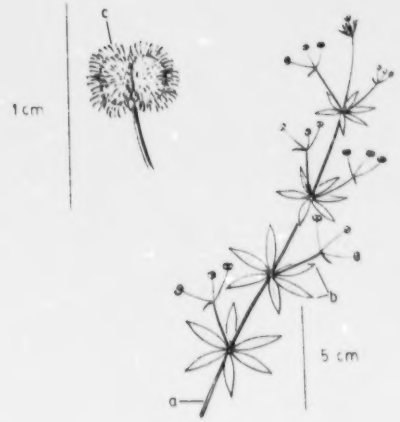


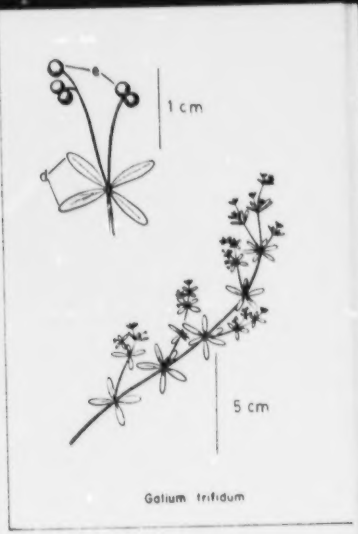
TROLLIUS LAXUS Salisb. White Globeflower

Features:
- -stems 1 - several, 1 - 4 dm tall.
- -basal leaves palmately cleft or divided into 5 obovate, 3-lobed and toothed segments; stem leaves 2 - 3.
- -flowers single; sepals (a) 5 - 9, greenish-white to creamy.
- -fruit (b) 8 - 11 mm long, strongly transversely nerved, papillate.

Habitat and Range:
Restricted to the ICHb and ESSF subzones although occasionally present in the adjoining subzones. It occurs on subhygric to subhydric and oligotrophic to eutrophic wet meadows where it is usually associated with *Lonicera involucrata*, *Equisetum arvense* and *Senecio triangularis*.





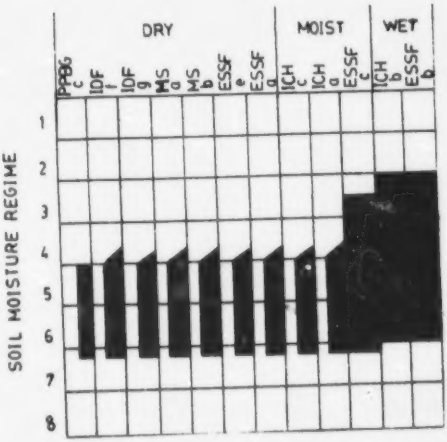


GALIUM TRIFLORUM Michx. Sweet-scented Bedstraw

Features:
- rhizomatous
- stems 4-angled (a), 2-8 dm long, rough to touch, prostrate, ascending, or scrambling on other vegetation.
- leaves vanilla-scented, 6 in a whorl, 4 on smaller branches, narrowly elliptic, rigidly sharp-pointed (b), 1.5-4.5 cm long, rough to touch.
- flower stems arising from leaf axils, 3-flowered at the end; flowers whitish, corolla 4-parted.
- fruit (c) covered with hooked bristles.

Note: *Galium trifidum* L. (Interior Small Bedstraw) is easily confused with *G. triflorum* but can be separated by the following features:
- mostly 1-3 dm long, stems much branched.
- leaves blunt (d), 5-20 mm long, not vanilla-scented, mostly in whorls of 4.
- corolla 3-parted.
- fruit smooth (e).

Habitat and Range:
Common in every subzone where it is found primarily on floodplains. Present on subhygric to hygric and mesotrophic to eutrophic sites in the PPBGc, IDFf, IDFg, MSa, MSb, ICHa, ICHc, ESSFa and ESSFe where it may also occur on drier sites having fine-textured, rich soils. Also present on submesic to hygric and oligotrophic to eutrophic sites in the ICHb, ESSFb and ESSFc.

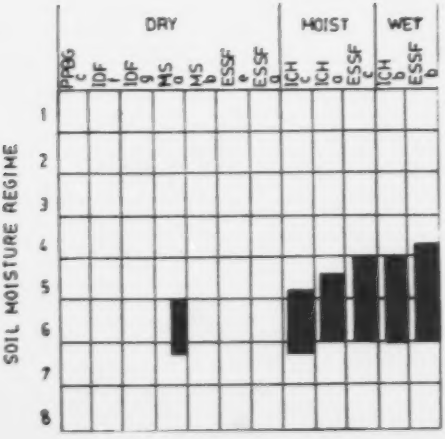


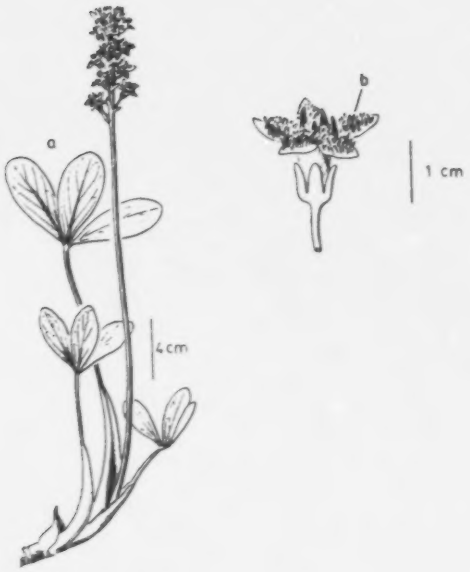
TIARELLA TRIFOLIATA L. Trifoliate-Leaved Foamflower

Features:
- basal leaves and single stem leaf divided into three leaflets (a), leaflets lobed and coarsely toothed.
- flowering stems 2-5.5 dm tall, glandular-hairy above.
- flowers (b) white in long inflorescence.

Note: *Tiarella unifoliata* Hook. (Unifoliate-leaved Foamflower) is very similar to *T. trifoliata* except that the leaves in *T. unifoliata* are not divided into three leaflets. The basal leaves are palmately 5-lobed for 1/4-1/2 their length and stem leaves are similar to basal leaves or more deeply 3-lobed.

Habitat and Range:
Present on subhygric to hygric and submesotrophic to eutrophic sites in all subzones except the MSa where it is restricted to hygric sites, and the PPBGc, IDFf, IDFg, MSb, ESSFa and ESSFe where it is absent.

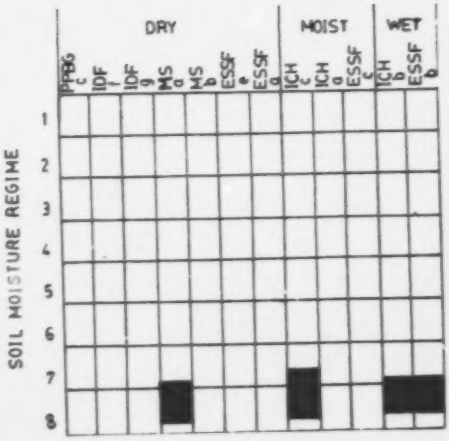


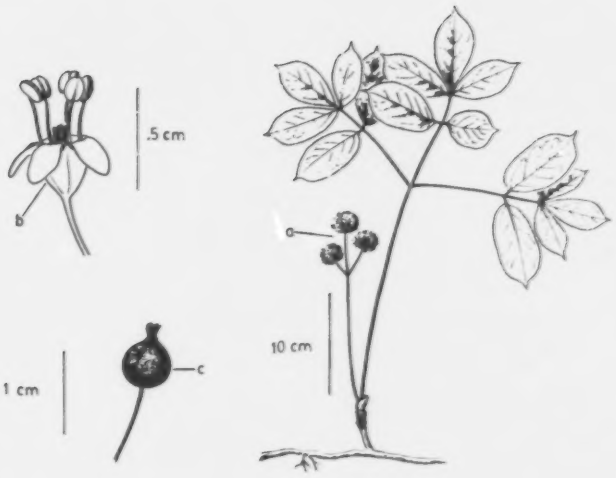


MENYANTHES TRIFOLIATA L. Buckbean

Features:
- rhizomatous.
- stems prostrate or floral branches ascending.
- leaves alternate, basal; leaf stems 10-30 cm long; leaf blades divided into three leaflets (a) which are short-stalked, elliptic-egg-shaped to obovate, 4-12 cm long, entire to coarsely wavy-toothed.
- inflorescence on long, leafless flower stem; corolla tube whitish, with 5 to 6 purplish-tinged lobes, densely bearded with slender bristle-like scales (b) inside tube and on lobes.

Habitat and Range:
This species has only been recorded in the MSa, ICHb, ICHc, and ESSFb. It is found in standing water and shallow lake margins.

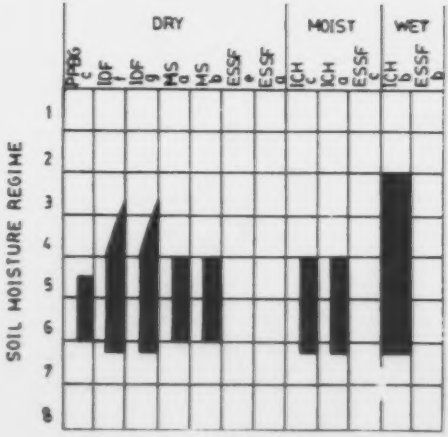


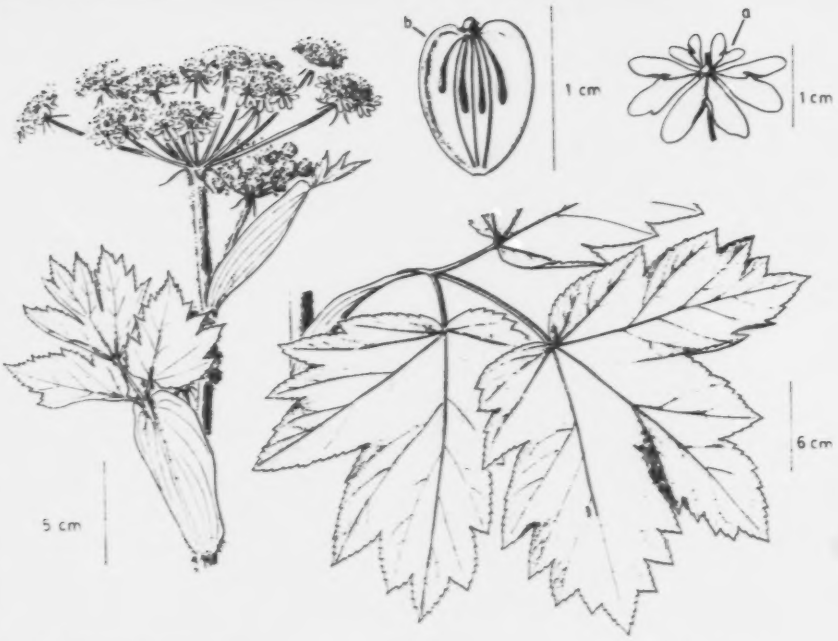


ARALIA NUDICAULIS L. Wild Sarsaparilla

Features:
- -rhizomatous.
- -leaves single, 3 - 5 dm long; leaf stem almost equalling the twice ternately compound leaf blade, ultimate leaflets egg-shaped-oblong, toothed to doubly-toothed, 5 - 12 cm long.
- -inflorescence (a) shorter than leaves, consisting of 3 - 7 spherical clusters of greenish-white flowers (b).
- -berries (c) dark purple.

Habitat and Range:
Commonly occurs on mesotrophic to eutrophic sites in all subzones except the subzones of the ESSF where it is absent. It is present on subhygric to hygric sites in the PPBGc, MSa, MSb, ICHa, and ICHc; on mesic to hygric sites in the IDFf and IDFg; and on submesic to hygric sites in the ICHb. This species commonly occurs with *Gymnocarpium dryopteris*.





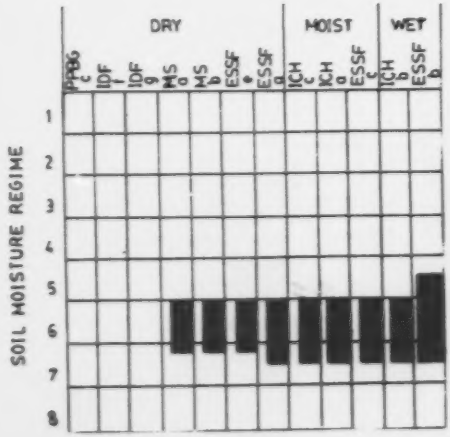
HERACLEUM SPHONDYLIUM L.
(*Heracleum lanatum* Michx.)

Common Cow-Parsnip

Features:

- single-stemmed perennial, 1-3 m tall, woolly hairy on lower surfaces of leaves and toward inflorescence.
- stems are hollow, ribbed, stout and have a spicy smell when crushed.
- leaves large, ternately divided, leaflets broad, coarsely toothed, palmately lobed.
- inflorescence of compound umbels on terminal and axillary stems; flowers (a) white or tinged with green or red, sweetly scented.
- fruit (b) circular to elliptic, strongly flattened, winged, pleasantly aromatic.

Habitat and Range:
Occurs in all subzones except the PPBGc, IDFf, and IDFg. It is present on hygric and submesotrophic to eutrophic sites in all subzones except the ESSFb where it is present on subhygric to hygric sites. This species is generally found on floodplains or streambanks in association with *Equisetum arvense*.



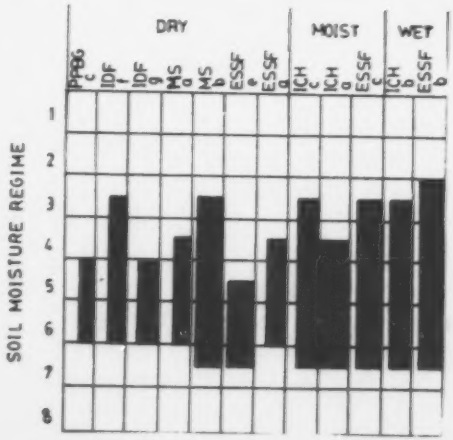
OSMORHIZA CHILENSIS H. & A. Mountain Sweetcicely

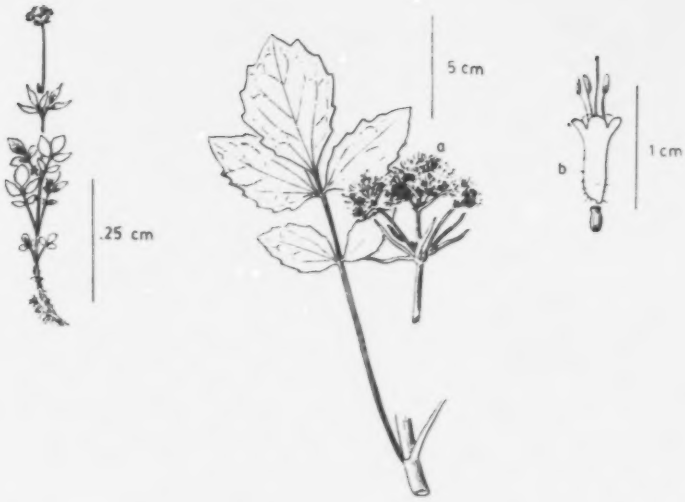
Features:

-perennial; stems 3 - 10 dm tall, purplish at base, with a distinctive spicy smell when crushed.
-leaves hairy, twice ternate, leaflets thin, egg-shaped, coarsely toothed; basal leaves several; stem leaves 1 - 3.
-stem usually branched above and producing several umbels; flowers (a) greenish-white.
-fruit (b) 1.2 - 2.2 cm, bristly, concavely narrowed to summit, the end 1 - 2 mm set off as a beaklike apex; stylopodium cone-like, as high as broad.

Habitat and Range:

Present on generally fine-textured soils on subhygric to hygric and submesotrophic to eutrophic sites in the PPBGc, IDFg, and ESSFe, and on submesic to subhydric sites in all other subzones.

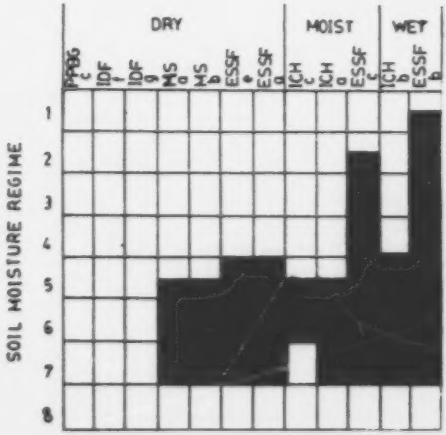


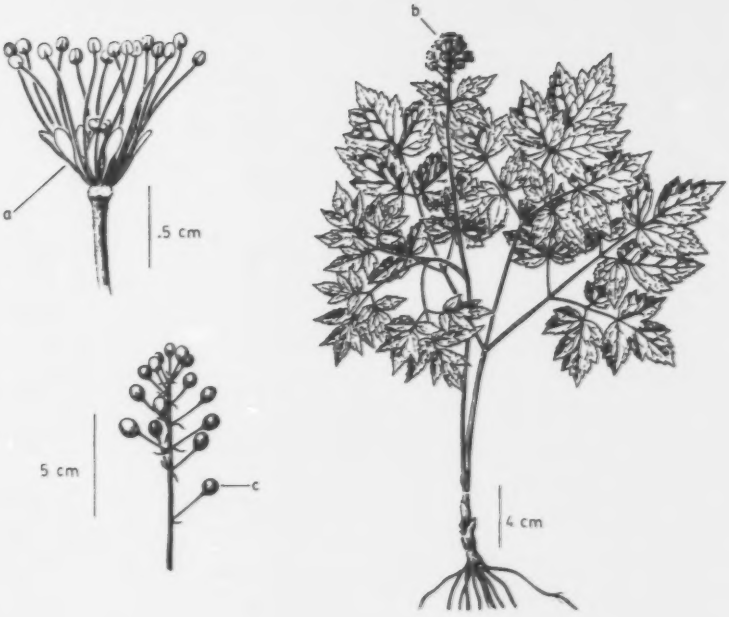


VALERIANA SITCHENSIS Bong. Sitka Valerian

Features:
- perennial, 3-12 dm tall, sweet scented.
- rhizome has a distinctive pungent odour when crushed.
- leaves opposite, mainly on stem, 2-5 pairs, lowermost one or two pairs reduced, those next above well-developed, pinnately divided, upper stem leaves reduced and becoming stalkless.
- inflorescence (a) compact, flowers (b) white; stamens well exserted.

Habitat and Range:
Most common in the ESSF subzones and in the upper elevations of the MSa, MSb, ICHa, ICHb, and ICHc. It occurs on subhygric to subhydric and oligotrophic to eutrophic sites in the MSa, MSb, ICHa, ICHb, ICHc, ESSFa, and ESSFe, and on a full range of sites in the ESSFb and ESSFc. Absent from the PPBGc, IDFf, and IDFg.

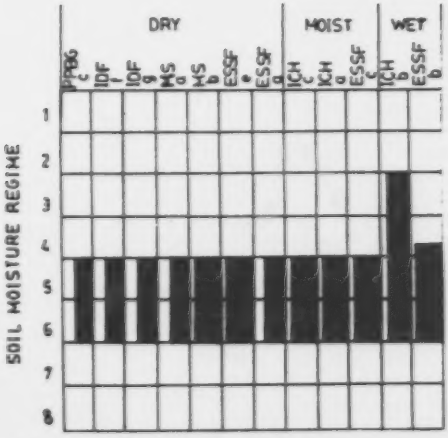


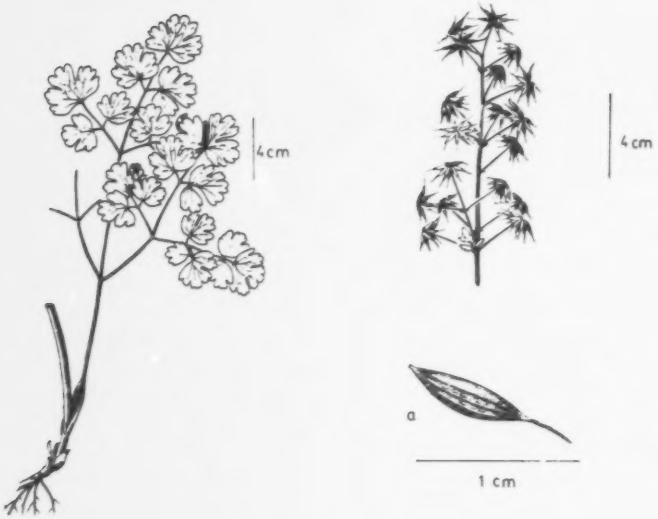


ACTAEA RUBRA (Ait.)Willd. Red Baneberry

Features:
-stems 1 - several, 4 - 10 dm tall, branched, sparsely hairy.
-leaves few, all on stem, 2 to 3 times ternate, segments egg-shaped, 3 - 9 cm long, sharply toothed and lobed.
-flowers (a) many in axillary and terminal inflorescences (b); sepals 3 - 5, whitish or purplish-tinged; petals 5 - 10, threadlike, white, often absent; stamens exceeding petals.
-berries (c) white or red.

Habitat and Range:
Commonly occurs in all subzones where it is often found on floodplains and streambanks. It is present on subhygric to hygric and submesotrophic to eutrophic sites in all subzones except the ICHb where it occurs on sites submesic and wetter. This species is often found in association with *Viburnum edule* and *Athyrium filix-femina*.





THALICTRUM OCCIDENTALE Gray

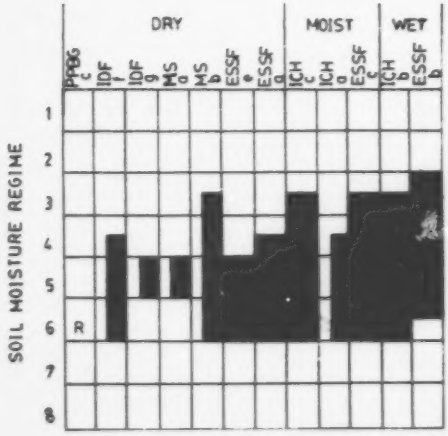
Western Meadow-Rue

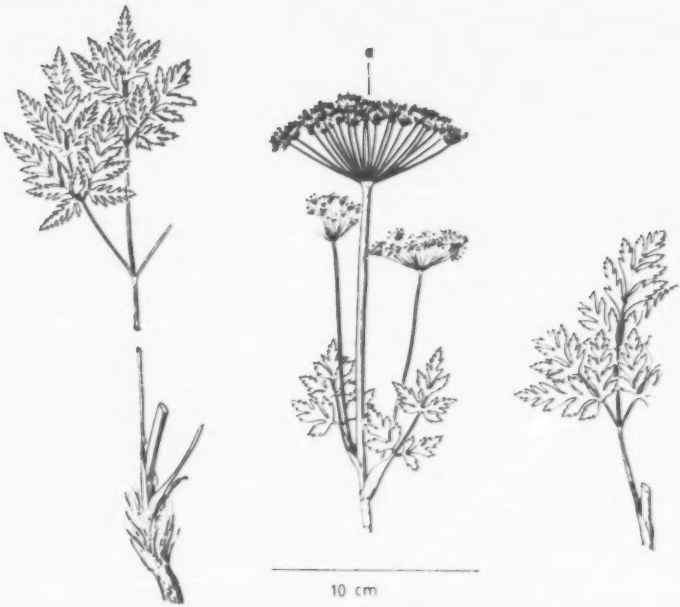
Features:

- perennial; 4-10 dm tall; male and female flowers on separate plants.
- leaves alternate, glandular beneath, 3-4 times ternate, leaflets triangular-egg-shaped, 1.5-3 cm long, rounded to heart-shaped at base, usually 3-lobed, lobes entire to less deeply 2- to 3-lobed or toothed, not prominently veined.
- inflorescence leafy bracteate, open; sepals greenish-white; stamens 15-30, stamen stalks purplish; pistils 5 or 6 with purple styles; petals absent.
- fruit (a) slightly flattened, elliptic spindle-shaped, with 3 prominent nerves on each side.

Habitat and Range:

Present on submesic to hygric and oligotrophic to eutrophic sites in every subzone except the IDFg, MSa and ESSFe where it occurs on subhygric to hygric sites. This species is usually associated with *Cornus canadensis* and *Lonicera involucrata*.

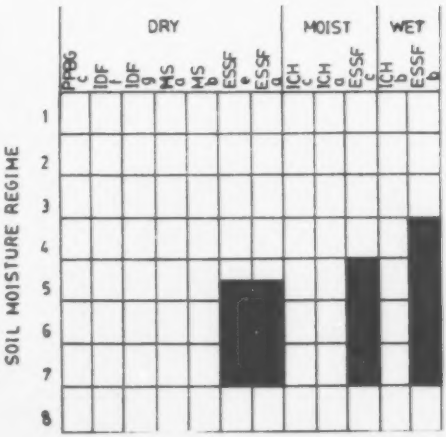


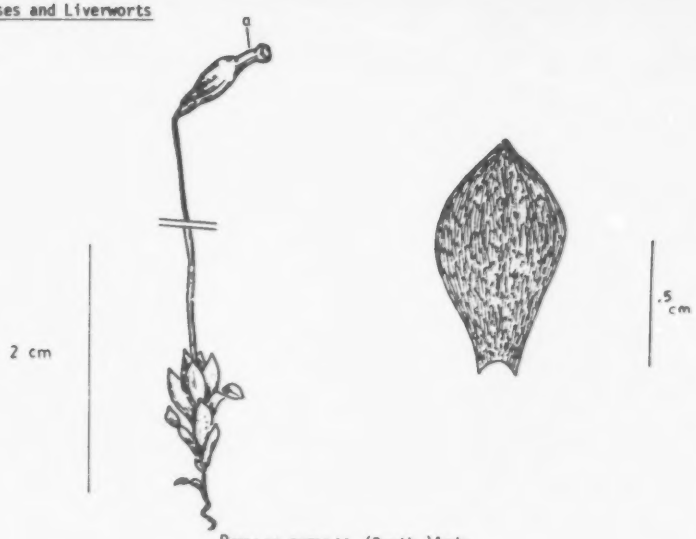


LIGUSTICUM CANBYI Coult. and Rose — Canby's Lovage

Features:
-herbs 5 - 12 dm tall, branched above.
-leaves dissected, with toothed or cleft leaflets up to 5 cm long; stem leaves 1 - several, reduced, but at least one still fairly well-developed; distinctive spicy aroma to leaves and stem when crushed.
-inflorescence is a terminal, compound umbel (a); flowers white.

Habitat and Range:
Restricted to subzones of the ESSF although it may occasionally be found in the upper elevations of the adjoining subzones. It is present on subhygric to subhydric and oligotrophic to eutrophic sites in the ESSFa, ESSFc and ESSFe, and on mesic to subhydric sites in the ESSFb.





ROELLIA ROELLII (Broth.)Andr.
(*Bryum sandbergii* Holz.)

Features:

Gametophytes
- loosely tufted or scattered, light green, glossy.
- stems erect, up to 2.5 cm high, reddish or brown.
- lower leaves small, egg-shaped; upper leaves large, in rosette, oblong or obovate, sharp-pointed; leaf margins curved under below, toothed in upper half; midrib ending before leaf tip.
- leaves scarcely contorted when dry.

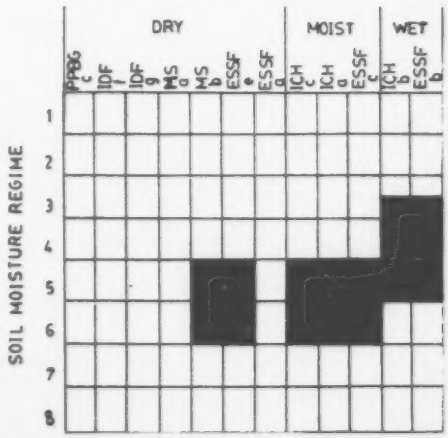
Sporophytes
- seta 3-5 cm long, yellow above, red below.
- capsule yellow to yellow-brown, urn cylindric or slightly curved, somewhat shrunken under the mouth when dry (a).
- peristome teeth yellow.

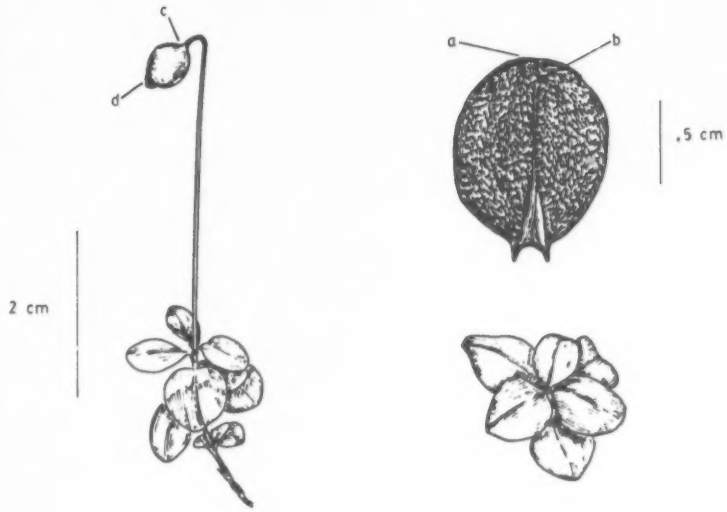
Note: *Bryum pseudotriquetrum* (Hedw.)Gaertn., Meyer and Scherb. can be separated from *Roellia roellii* by the following features:

Gametophytes
- plants green to reddish-brown.
- stems 2-8 cm tall, sometimes branching, with dense growth of reddish-brown rhizoids.
- leaf margins curved under nearly to leaf tip; midrib ending at leaf tip, sometimes extending shortly beyond leaf tip in upper leaves; leaves erect-spreading when moist, closely overlapping,more often twisted when dry.

Sporophytes
- seta reddish-brown.
- capsule brown, reddish-brown or red.

Habitat and Range:
Present on subhygric to hygric and oligotrophic to eutrophic sites in the MSb, ICHa, ICHc, ESSFc, and ESSFe, and on submesic to subhygric sites in the ICHb and ESSFb. This species has not been recorded in the PPBGc, IDFf, IDFg, MSa, and ESSFa.





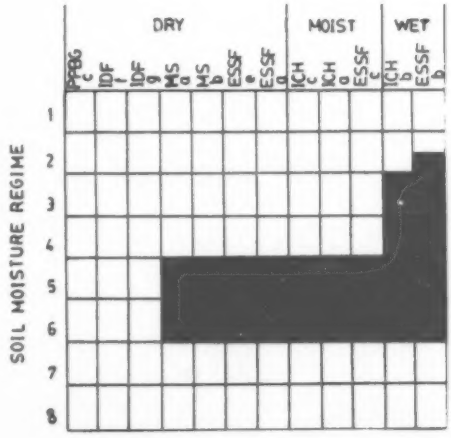
MNIUM NUDUM Williams

Features:

Gametophytes
- plants dark green, loosely tufted.
- stems reddish-brown, erect, simple, 1-5 cm high; rhizoids at base.
- leaves very glossy, broadly elliptic - circular, entire, leaf tip rounded (a); midrib red, ending before leaf tip (b); leaves only slightly contorted when dry.
- antheridia numerous,

Sporophytes
- seta reddish-brown, 1-2.5 cm long.
- capsule yellow-brown, oval, rounded to seta (c), urn irregularly wrinkled when dry.
- peristome teeth (d) greenish-yellow.

Habitat and Range:
Common on oligotrophic to eutrophic sites in all subzones except the PPBGc, IDFf and IDFg where it is absent. It occurs on subhygric to hygric sites in the MSa, MSb, ICHa, ICHc, ESSFa, ESSFc and ESSFe, and on submesic to hygric sites in the ICHb and ESSFb. This species is usually found with *Athyrium filix-femina* and *Gymnocarpium dryopteris*.



Note: *Mnium punctatum* Hedw. is easily confused with *Mnium nudum* but can be separated by the following features:

Gametophytes

- stems covered with thick mat of rhizoids almost to the tip.
- leaves elliptic-obovate, rounded to notched at leaf tip; midrib ending at or near leaf tip; leaves usually contorted when dry.

Sporophytes

- operculum is beaked.
- seta 2-4 cm long.
- capsule short-cylindric.

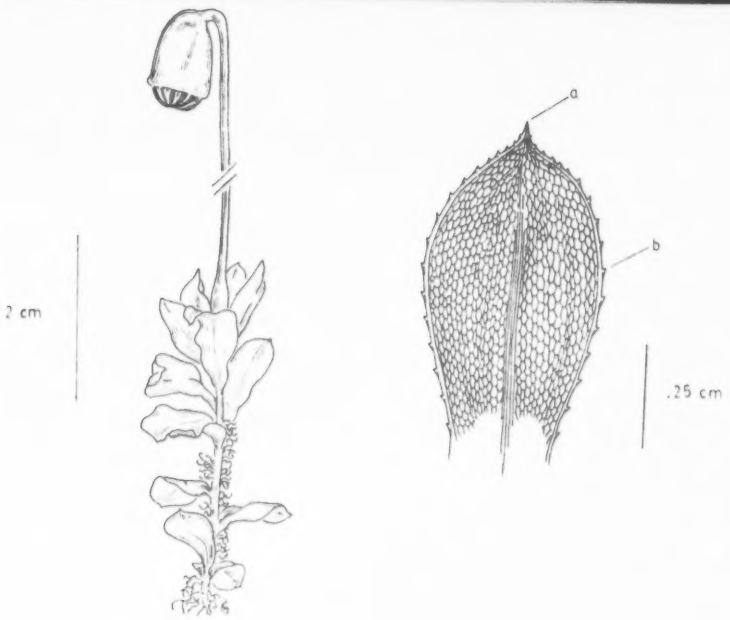
Mnium pseudopunctatum Bruch and Schimp. may also be confused with *M. nudum* but can be separated by the following features:

Gametophytes

- very similar to *M. nudum* except that leaves are obovate rather than broadly elliptic-circular. Also, stems are 2-5 cm tall.
- antheridia and archegonia are together in one cluster whereas *M. nudum* and *M. punctatum* have antheridia and archegonia on separate plants.

Sporophytes

- seta yellow-brown to reddish, 2-5 cm long.
- operculum beaked.
- peristome teeth brown; capsule oval, yellow-brown.



MNIUM RUGICUM Laur.

Features:

Gametophytes

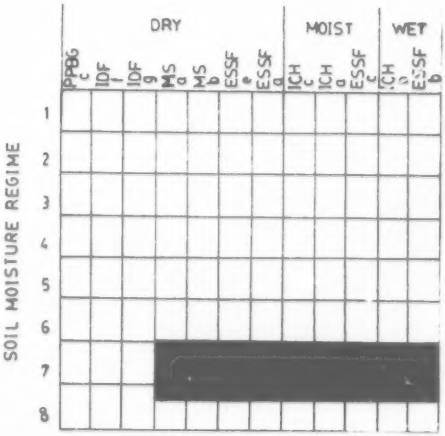
- plants green, in tufts or mats.
- fertile stems erect, 2-5 cm high; sterile stems horizontal to 10 cm long.
- leaves egg-shaped to oblong-elliptic, rounded at base and leaf tip, with a stiff, acute point (a); leaf margins singly blunt-toothed (b); midrib reaching leaf tip or extending slightly beyond leaf tip in stiff point, midrib ending before leaf tip in lower leaves; leaves spreading when wet, twisted when dry.

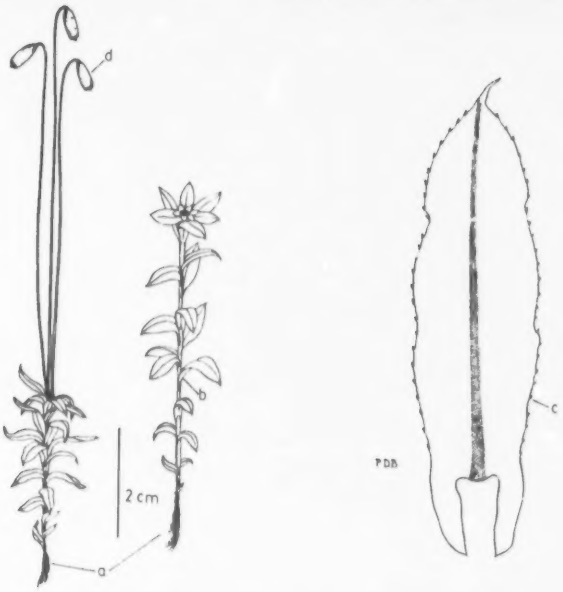
Sporophytes

- capsules rare.

Habitat and Range:

Present on subhydric and oligotrophic to eutrophic bogs or fens in all subzones except the PPBGc, IDFf, and IDFg where it is absent. This species characteristically occurs with *Sphagnum capillaceum*, *Salix planifolia* and *Carex aquatilis*.





MNIUM INSIGNE Mitt.

Features:

Gametophytes

- plants green, erect, unbranched, 3-6 cm tall; loose turfs formed by stoloniferous shoots 2-5 cm long arching among erect shoots.
- stem red-brown, rhizoids (a) numerous near base.
- leaves of erect shoots forming rosettes at apex of shoot; rosette leaves 0.2-1.0 cm long, oblong-egg-shaped, with strongly decurrent base (b); leaf margin with a narrow, colourless ridge around leaf and conspicuous single row of sharp teeth (c), leaf tip sharply pointed; midrib forming ridge on back of leaf; leaves spreading when moist, curved backward and much contorted when dry.

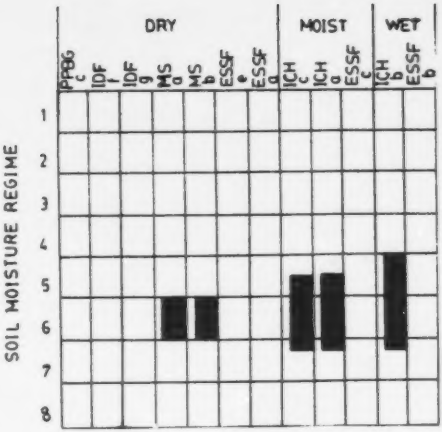
Sporophytes

- apical on archegonial plants, 2-5 from each perichaetium (several perichaetia per archegoniate plant).
- calyptra yellowish, early deciduous.
- seta red-brown in lower half, becoming pale yellow above, 3-4 cm tall.
- capsule (d) nodding, yellow, cylindric.
- operculum short coneshaped.
- maturing in spring.

Mnium insigne (Continued)

Habitat and Range:

This species is generally found on submesotrophic to eutrophic floodplains and receiving slopes. It occurs only in the MSa and MSb on hygric sites and in the ICHa, ICHb, and ICHc on subhygric to hygric sites.



Note: *Mnium spinulosum* B.S.G. can be separated from *Mnium insigne* by the following features:

Gametophytes

- dark green, forming loose turf 1-2 cm deep.
- leaves obovate, 2-2.5 mm long and 1.5 mm wide; leaf margin differentiated as a colourless or reddish-brown ridge, with double row of sharp teeth in upper part; leaves spreading when moist, slightly twisted when dry.

Sporophytes

- seta 1.5 cm long
- capsule elliptic, tapering to seta.
- operculum narrowed to form long tip.
- peristome teeth dark purplish brown, papillose.

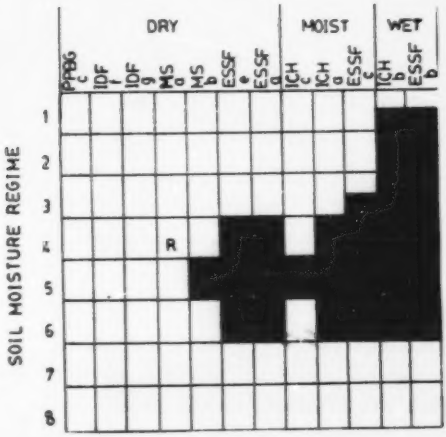
PLAGIOTHECIUM LAETUM B.S.G.

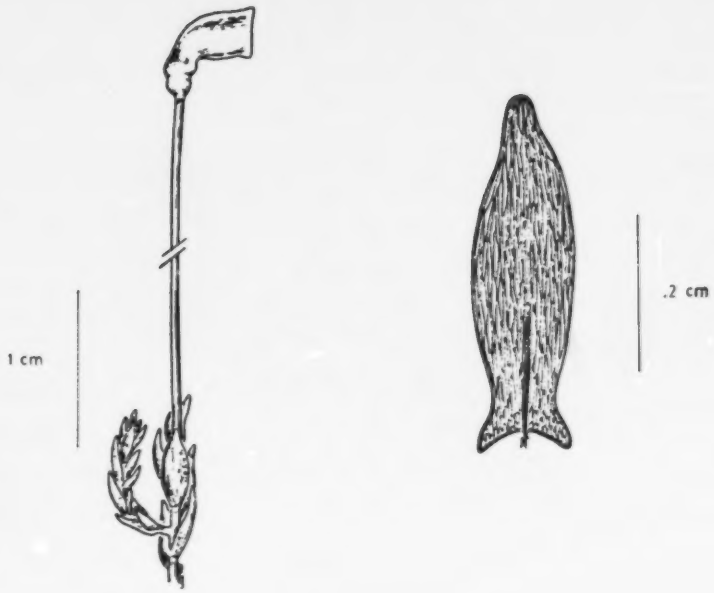
Features:

Gametophytes
- plants light green, glossy, branched.
- stems to 2 cm long, stems and branches prostrate, flattened.
- leaves closely overlapping, often slightly wavy, oblong-egg-shaped or egg-shaped-lance-shaped, gradually tapering to narrow point; leaf margins flat or often narrowly rolled backwards, entire, sometimes toothed at apex.
- archegonia and antheridia on same plant in separate clusters.

Sporophytes
- seta 1-1.6 cm long, orange-brown to red.
- capsules light brown to orange-brown when mature, urn smooth when dry.

Habitat and Range:
Common on a broad range of nutrient regimes in all subzones except the PPBGc, IDFf, and IDFg where it is absent. Present on subhygric sites in the MSb and ICHc; on mesic to hygric sites in the MSa, ICHa, ESSFa and ESSFe; and on xeric to hygric sites in the ICHb, ESSFb, and ESSFc.





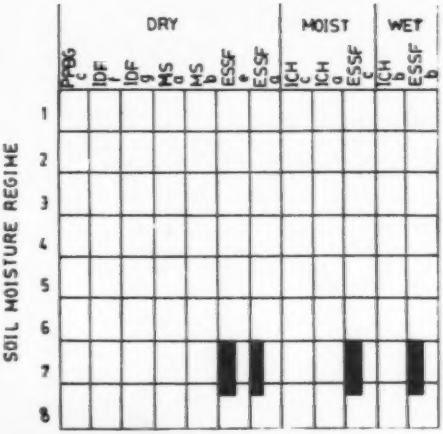
CALLIERGON STRAMINEUM (Brid.)Kindb.

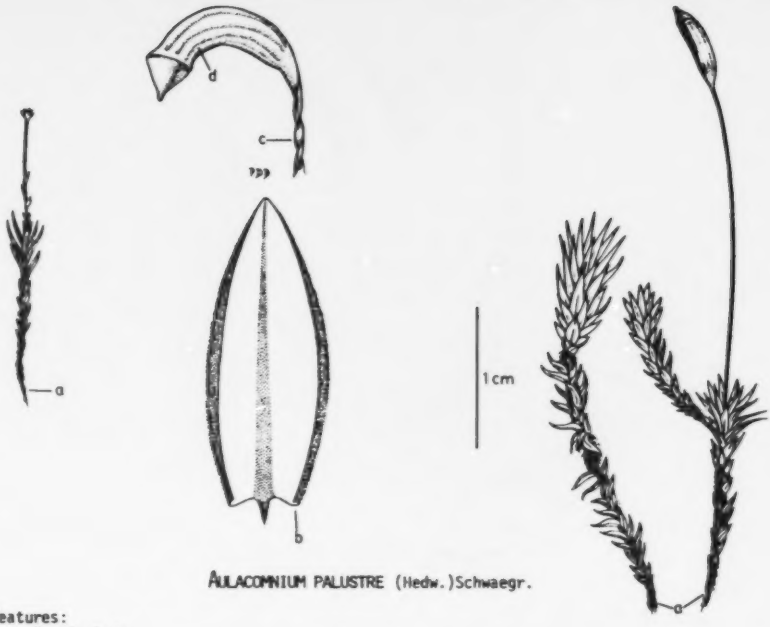
Features:

Gametophytes
- plants in loose tufts or mats, light green, simple or sparsely branched.
- stems 5-10 cm long with a stiff, acute point at stem or branch tips.
- stem leaves crowded, closely overlapping, elongate-egg-shaped to somewhat oblong, blunt, shallowly concave; branch leaves similar or smaller; leaf margins entire, flat; midrib weak, 1/2 to 3/4 leaf length; leaves contorted and sometimes weakly folded or pleated when dry.

Sporophytes
- seta 3-5 cm long.

Habitat and Range:
Restricted to the subzones of the ESSF where it is usually found in standing water with *Sphagnum capillaceum* or *Sphagnum aquarrosum* on subhydric and oligotrophic to mesotrophic bogs.





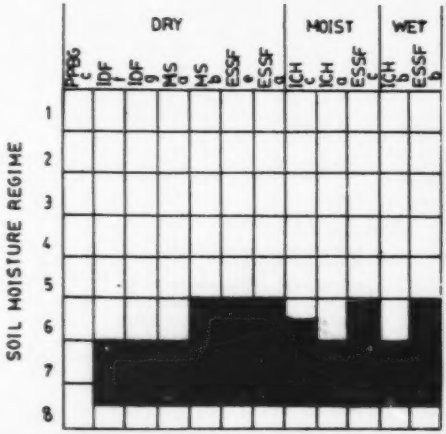
AULACOMNIUM PALUSTRE (Hedw.)Schwaegr.

Features:

Gametophytes
- yellow-green, forming turfs of erect plants 5-10 cm deep.
- stems green, with red rhizoids (a) among leaf bases.
- leaves toothed near tip, lance-shaped to egg-shaped, sharp-pointed; midrib distinct, pale-green; margins curved under (b).
- leaves erect - spreading when wet, crisped when dry.

Sporophytes
- at tip of main shoot.
- seta (c) 3-4 cm long, strongly twisted when dry.
- capsule red-brown, cylindric, strongly grooved longitudinally (d).
- peristome yellowish to pale brown, curved inward when dry.
- maturing in summer.

Habitat and Range:
Present in all subzones except the PPBGc. Occurs on hygric to hydric and oligotrophic to eutrophic sites. This species is usually found in standing water, in wet depressions, bogs or fens.



DREPANOCLADUS UNCINATUS (Hedw.)Warnst.

Features:

Gametophytes
- plants in loose mats, light-green or yellowish, glossy.
- stems irregularly to almost pinnately-branched, 2-8 cm long.
- leaves close, strongly curved and turned to one side, strongly pleated, narrowly elongate-lance-shaped, gradually tapering to long narrow point; midrib (a) extending well into leaf tip; leaves hooked at end of stems and branches (b); perichaetial leaves very long and sheathing; leaves not crisped when dry.
- male and female reproductive organs on same plant in separate clusters.

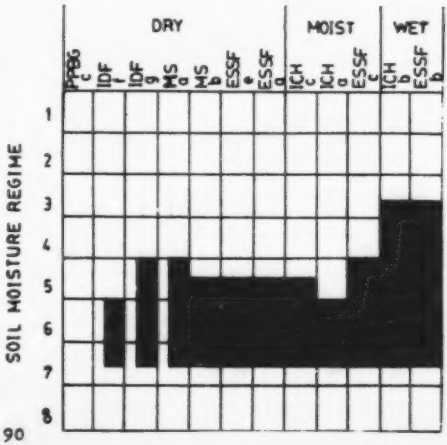
Sporophytes
- seta 1.5-3 cm long, red, twisted when dry (c).
- capsule brown, contracted below mouth when dry (d).
- operculum cone-shaped.
- maturing in summer.

Note: *Drepanocladus exannulatus* (B.S.G.)Warnst. is easily confused with *D. uncinatus* but can be separated from it by the following features:

Gametophytes
- plants yellow-green to brown or often red to purplish.
- stems 5-18 cm long.
- leaves straight, or slightly curved, broadly egg-shaped-lance-shaped, blunt, flat or weakly grooved when dry; leaf margins toothed; midrib red or brown, sometimes ending at or beyond leaf tip.

Sporophytes
- seta 5-6 cm long.

Habitat and Range:
Common on a broad range of nutrient regimes in all subzones except the PPBGc where it is absent. Present on subhygric to hygric sites in all subzones except the ICHb and ESSFb where it occurs on submesic to hygric sites. It is usually found on moist slopes, floodplains, bogs and fens.



SPHAGNUM CAPILLACEUM (Weiss)Schrank

Features:

Gametophytes

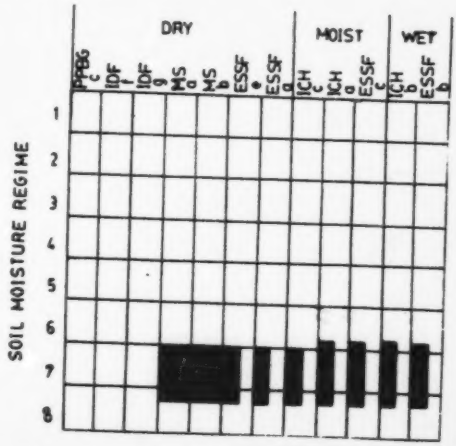
- plants erect, in pale green to deep red compact tufts; with tapering branches 3-10 mm long in clusters, 3-5 branches per cluster, 2-3 angled outward from stem (a), remainder clinging downward on stem; shoot tip a tight rounded cluster of bluntish branches (b).
- stems reddish, 5-15 cm long.
- stem leaves egg-shaped, very concave; leaf margin entire, inrolled at leaf tip; branch leaves narrowly egg-shaped, tapering to a 4-5 toothed and inrolled leaf tip (c); no midrib.

Sporophytes

- on short stalk, 1-2 mm long.
- capsule dark brown, almost spherical, 1-1.5 mm long, contracted around equator when dry.
- no peristome.
- maturing in summer but not commonly observed.

Habitat and Range:

Common primarily on organic soils in bogs in all subzones except the PPBGc, IDFf and IDFg where it is absent. Present on subhydric and oligotrophic to eutrophic sites in the MSa and MSb, and on subhydric and oligotrophic to mesotrophic sites in all subzones of the ICH and ESSF zones.



Note: Two species similar to *Sphagnum capillaceum* are *Sphagnum girgensohnii* Russ. and *Sphagnum subsecundum* Nees.

Sphagnum girgensohnii can be separated from *Sphagnum capillaceum* by the following features:

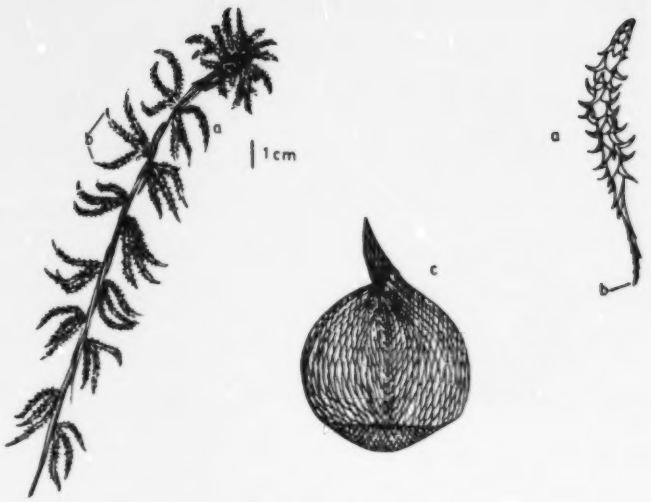
Gametophytes

- plants green, yellowish or brownish, never reddish.
- branches 1.5-2.5 cm long, curved and deflexed, pendent branches not lying close to stem.
- stem leaves medium-sized, tongue-shaped, as long as broad; branch leaves very closely overlapping to somewhat spreading out at right angles.

Sphagnum subsecundum is exceedingly variable in all characteristics but can be separated from *Sphagnum capillaceum* by the following features:

Gametophytes

- plants never a rose-red but usually bright orange-brown.
- head narrow, with crown branches curly, all branches short, divergent branches of branch clusters curved.
- stems not red.
- branch leaves boat-shaped, slightly curved and orientated to one side to closely overlapping; stem leaves triangular-tongue-shaped to oval, leaf tips broadly rounded.



SPHAGNUM SQUARROSUM Crome

Features:

Gametophytes

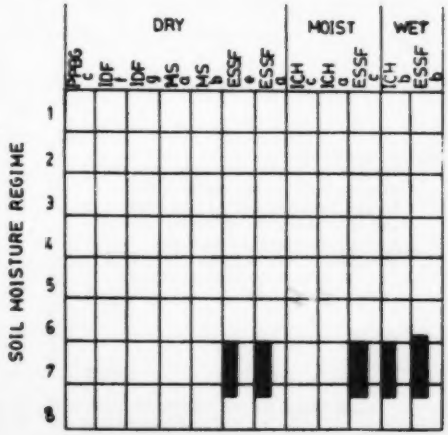
- erect, pale green plants forming loose mats 5-10 cm deep.
- lateral branches in clusters of 5, 2-3 spreading outward from stem, remainder clinging downwards on stem, 1-1.5 cm long, appearing bristly (a) due to leaves spreading out at right angles to the stem, branches tapering to the apex (b).
- apical clusters of branches crowded into a head.
- stem leaves spatula-shaped with long fringe across wide leaf tip.
- branch leaves (c) broadly egg-shaped, sharp-pointed tip at right angles to stem; no midrib.
- perichaetial leaves larger than others, on swollen short branches in apical tuft.

Sporophytes

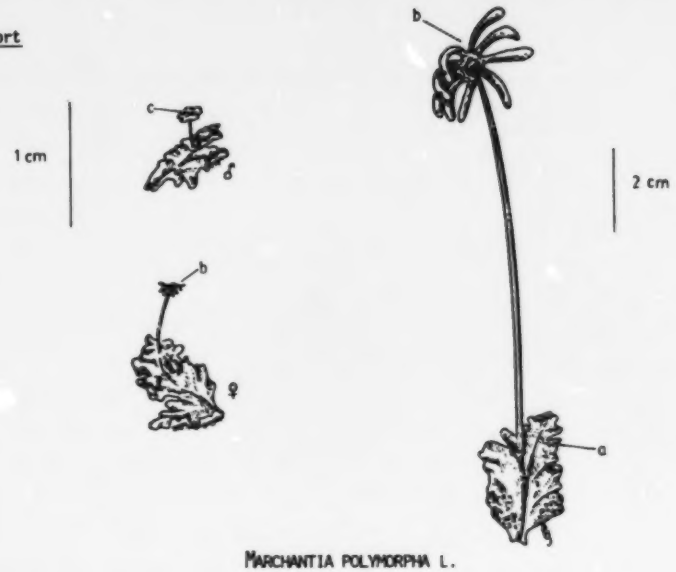
- capsule erect, dark brown, almost spherical, borne on stalk 6-7 mm long, exserting it well beyond perichaetial leaves, contracted below mouth when dry.
- operculum convex; no peristome.
- maturing in summer.

Habitat and Range:

Restricted to subhydric and oligotrophic to mesotrophic sites in the ICHb and all subzones of the ESSF. This species occurs primarily on mineral soils with water at the surface.



Liverwort



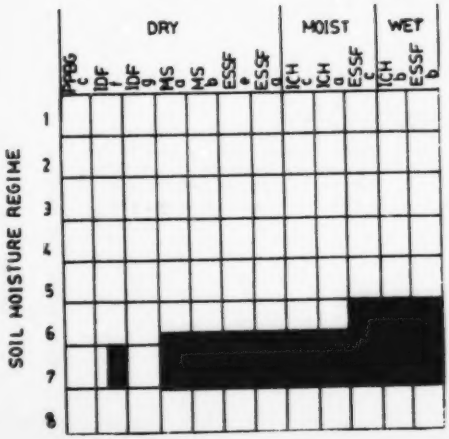
MARCHANTIA POLYMORPHA L.

Features:

- thallus green or brownish, prostrate, linear or oblong, 5 - 25 cm long, 2 - 10 cm wide; midrib wide (a); margins wavy curled or lobed; ventral surface brownish; rhizoids numerous; ventral scales in 3 rows on each side of midrib.
- male and female reproductive organs on same plant; female reproductive organ stellate (b) with 9 finger-like projections, male reproductive organ disc-like (c), long-stalked; margin thin, round-toothed.
- gemmae cups round; gemmae round-kidney-shaped.

Habitat and Range:

Present on hygric to subhydric and oligotrophic to eutrophic sites in all subzones except the PPBGc and IDFg where it is absent. This species is usually found on streambanks and seepage sites and is also common in wet, disturbed areas.



Glossary of Plant Terms

Achene: a small, dry, one-celled, one-seeded fruit; not opening by definite lines or pores. See *Carex* spp. and *Eriophorum angustifolium*.

Acute: tapering to the apex with the sides straight or nearly so; sharp pointed. See *Mnium rugicum*.

Alternate: usually referring to leaves; alternating at different levels on opposite sides of the stem; not in opposite pairs or whorls. See Figure 4.

Antheridium: the male reproductive organ in mosses containing the sperms (plural- antheridia). See *Mnium nuchum*.

Apical: belonging to the apex or tip. See *Sphagnum squarrosum*.

Archegonium: the female reproductive organ in mosses and liverworts containing the egg (plural - archegonia). See *Mnium pseudopunctatum*.

Auricle: an ear-shaped lobe or appendage; in grasses, it is applied to the ear-like lobes at the base of the leaf blades. See *Elymus glaucus*. Also see Figure 9.

Awn: a bristle-like appendage; in grasses, the awn is usually a continuation of the mid-nerve of the glumes or lemmas;

Axil: the angle formed between two organs, as between a leaf and a stem. See *Lonicera involucrata*.

Axillary: located in or arising from an axil. See *Ledum groenlandicum* and *Heracleum sphondylium*.

Beak: a prolonged, ± slender tip on a thicker organ such as a fruit or seed. See *Carex disperma* and *Caltha leptosepala*.

Bipinnate: doubly or twice-pinnate, the primary divisions once-again pinnate. See Figure 5.

Biternate: two times ternate. See Figure 5.

Bract: a more or less modified leaf subtending a flower or a flower cluster. See *Lonicera involucrata* and *Platanthera dilatata*.

Bracteate: having bracts. See *Thalictrum occidentale*.

Bractlet: a secondary bract, often very small, subtending an individual flower of an inflorescence, or a secondary inflorescence in a compound inflorescence. See *Tofieldia glutinosa*.

Calyptra: in mosses, a small sheath that covers the young capsule and which falls off before the operculum is shed. See Figure 10.

Calyx: all the sepals of a flower, collectively.

Capsule: 1) in vascular plants, a dry fruit opening at maturity and composed of more than one carpel, usually several - to many - seeded.
2) in mosses, the spore-containing sac which, with the seta and foot compose the sporophyte. See Figure 10.

Catkin: an elongate, deciduous cluster of unisexual, apetalous, and usually bracteate flowers, as in willows. See *Salix planifolia*.

Cilia: marginal hairs. See *Streptopus amplexifolius*.

Ciliate: fringed with marginal hairs. See Figure 6.

Cleft: cut in about halfway to the midvein or base; deeply lobed. See *Trollius laxus*.

Collar: in grasses, the outer side of the leaf at the place where the blade and sheath come together. See *Elymus glaucus*. Also see Figure 9.

Cordate: having the shape of a stylized heart, with a basal notch. See Figure 3.

Corolla: all of the petals of a flower, collectively.

Culm: the flowering stem of a grass or sedge. See Figure 9.

Decurrent: extending downward from the point of insertion; as leaves having their bases prolonged downward as wings along the stem. See *Mnium insigne*.

Deflexed: abruptly bent downwards. See *Sphagnum girgensohnii*.

Deltoid: shaped like an equilateral triangle. See Figure 3.

Dicot (Dicotyledonese): distinguished by the presence of two seed leaves (cotyledons) in the embryo, net-veined leaves (never parallel veined) and flower parts in fours or fives or in multiples of these numbers.

Divergent: inclining away from one another. See *Sphagnum subsecundum*.

Entire: with an unbroken or even margin; without teeth or lobes. See *Lonicera involucrata* and *Streptopus roseus*. Also see Figure 6.

Exserted: projecting beyond a surrounding organ, as stamens from a corolla. See *Valeriana sitchensis*.

Floret: in grasses, a flower with its lemma and palea included. See *Calamagrostis canadensis*.

Frond: the leaf of a fern. See *Gymnocarpium dryopteris*. Also see Figure 7.

Gametophyte: in mosses, the sexual stage of plants bearing sperm and/or eggs. See all mosses. Also see Figure 10.

Gemmae: in liverworts, the asexual or vegetative outgrowths of a parent body which are capable of growing into new individuals directly. See *Marchantia polymorpha*.

Glumes: the two empty chaffy bracts at the base of the spikelet in the grasses.

Inequilateral: having two sides unequal. See *Dryopteris assimilis*.

Inflorescence: a flower cluster of a plant. See *Smilacina racemosa* and *Tofieldia glutinosa*.

Internode: the portion of a stem between two adjacent nodes. See *Equisetum* spp. Also see Figure 4.

Lanceolate: lance-shaped; commonly several times longer than broad, broadest toward the base and tapering to the apex. See Figure 3.

Lemma: the outer of the two bracts of the floret of grasses.

Ligule: a term applied to the small, membranous appendage on the inner side of the leaf at the junction of blade and sheath in many grasses and some sedges. Also applied to the flattened part of the ray corolla in the Compositae. See Figure 9.

Linear: long and narrow with parallel sides. See Figure 3.

Lobe: a projecting segment of an organ. See *Petasites palmatus* and *Thalictrum occidentale*.

Membranous: thin, flexible, and more or less translucent.

Node: the point on a stem where leaves or branches are attached. See *Streptopus* spp. Also see Figures 4 and 9.

Oblanceolate: inversely lance-shaped, attached at the tapered end. See *Salix planifolia*. Also see Figure 3.

Oblong: longer than broad, the ends rounded, with sides nearly parallel. See Figure 3.

Obovate: inversely egg-shaped, attached at the narrow end. See *Salix planifolia* and *Pyrola asarifolia*. Also see Figure 3.

Operculum: the deciduous lid covering the apex of a moss capsule. See Figure 10.

Opposite: situated directly across from each other at the same node. See Figure 4.

Orbicular: circular in outline. See Figure 3.

Oval: broadly elliptic, the width more than half the length. See Figure 3.

Ovate: egg-shaped in outline, attached at the broader end. See Figure 3.

Palea: the inner and usually smaller of the two scaly bracts immediately subtending the grass flower in a spikelet.

Palmate: with 3 or more parts arising from a common point. For palmately lobed and veined and palmately cleft, see Figure 6.

Papillate, papillose: covered with short, rounded, blunt projections. See *Carex limosa* and *Trollius laxus*.

Parallel Veined: leaf veins parallel to one another and connections between obscure. See Figure 6.

Pendent: hanging. See *Sphagnum girgensohnii*.

Perianth: the calyx and corolla collectively. See Figure 8.

Perichaetium: the apex of a shoot containing the female sex organs and from which the sporophyte arises. See Figure 10.

Perigynium: a special bract which encloses the achene of *Carex*. (Plural: perigynia).

Peristome: the apical opening of the moss capsule through which spores are shed, often ringed by peristome teeth. See Figure 10.

Petiole: the stalk of a leaf. See *Populus tremuloides*. Also see Figure 4.

Pinnate: compound, with the leaflets or pinnae arranged on opposite sides of a common axis, like a feather. See *Athyrium filix-femina* and *Mitella breweri*. Also see Figure 5.

Pinnately Veined: leaf veins arranged in two rows of lateral veins along the midrib, like the barbs on a feather. See Figure 6.

Pistil: the female reproductive organ of a flower, consisting typically of an ovary, style and stigma. See Figure 8.

Pistillate: refers to a flower with one or more pistils but no stamens. See *Carex* spp.

Reniform: kidney-shaped, usually attached at the center of the incurved side. See Figure 3.

Rhizoids: filamentous much-branched strands usually red-brown in colour, generally on the stems of mosses, often fixing the moss to its substrate. See Figure 10.

Rhizomatous: bearing rhizomes. See *Smilacina* spp.

Rhizome: any prostrate more or less elongated stem growing partly or completely beneath the surface of the ground; usually rooting at the nodes and progressively sending up stems, branches or leaves from its upcurved apex. See *Athyrium filix-femina* and *Gymnocarpium dryopteris*. See Figures 7 and 9.

Scale: any small, membranous, thin or flat structure. See *Dryopteris assimilis* and *Carex* spp. Also see Figure 7.

Sepal: a member of the outer set of floral leaves, typically green or greenish and somewhat leafy in texture. See *Trillium ovatum*, *Caltha leptosepala* and *Asarum caudatum*. Also see Figure 8.

Sessile: attached directly by the base, without a stalk.

Seta: in mosses, the stalk of the sporophyte. See Figure 10.

Sheath: a tube-like organ which partly or wholly surrounds another organ, as the sheath of a grass leaf which surrounds the stem. See *Equisetum* spp. Also see Figure 9.

Simple Leaf: having the blade in one piece. See Figure 5.

Spike: an unbranched, elongate inflorescence of sessile or almost sessile flowers with the younger flowers at the top. See *Carex disperma*.

Spikelet: the unit of inflorescence in grasses, consisting of two glumes and one or more florets.

Spinule: a small spine. See *Equisetum sylvaticum*.

Sporophyte: in mosses, the asexual, spore-bearing stage. See Figure 10.

Spur: a hollow, sac-like or tubular projection of a sepal or petal, usually nectariferous within at base, as in *Platanthera* spp. and *Viola* spp. See Figure 8.

Stamen: the male, pollen-bearing organ of a flower, consisting of an anther and generally a filament. See Figure 8.

Staminate: refers to a flower with one or more stamens, but no pistil. See *Carex* spp.

Stellate: star-shaped.

Stigma: the part of the pistil which is receptive to pollen, generally terminal in position, and often enlarged. See *Carex* spp. Also see Figure 8.

Stipe: the petiole of a fern leaf. See Figure 7.

Stipule: one of a pair of commonly bract-like or leaf-like appendages present at the base of a petiole or a sessile leaf. See *Viola glabella*.

Stoloniferous: bearing an elongate, creeping, horizontal stem above ground, that may root at the nodes and apex. See *Mnium insigne*.

Style: the slender stalk of a pistil which connects the stigma to the ovary. See Figure 8.

Stylopodium: an enlargement or disc-like expansion at the base of a style. See *Osmorhiza chilensis*.

Subtend: to occur immediately below and close to, as a bract subtending a flower. See *Tofieldia glutinosa* and *Carex aquatilis*.

Ternate: palmately in threes, as a compound leaf with three primary axis. See *Aralia nudicaulis* and *Heracleum sphondylium*. Also see Figure 5.

Thallus: a plant body which is not differentiated into stems, leaves and roots. See *Marchantia polymorpha*.

Tripinnate: refers to a leaf or frond which is three times pinnately divided into separate segments; the pinnules are again pinnate. See *Dryopteris assimilis*. Also see Figure 5.

Triternate: three times ternate; ternate with the three main divisions once and once-again ternate. See Figure 5.

Turfs: mosses having the shoots parallel and upright as in the pile of a carpet. See *Aulacomnium palustre* and *Mnium spinulosum*.

Umbel: a flat-topped or rounded inflorescence having flowers on stalks of nearly equal length and attached to the summit of the inflorescence stalk, the characteristic order of blooming being from the outside toward the center. See *Heracleum sphondylium* and *Osmorhiza chilensis*.

Urn: the spore-bearing part of the capsule in mosses.

Whorled: having three or more leaves or other structures arranged in a circle around a stem or some common axis. See *Equisetum arvense* and *Galium* spp. Also see Figure 4.

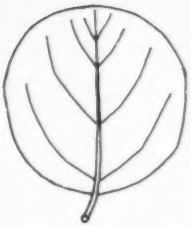
Figure 3. Leaf Shape

Linear

Oblong

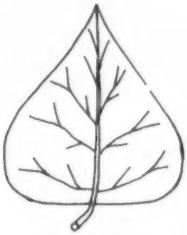
Lanceolate or
Lance-shaped

Oval

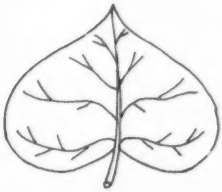


Orbicular or
Circular

Cordate or
Heart-shaped



Deltoid
or Triangle-shaped

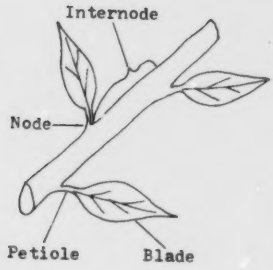


Reniform
or Kidney-shaped

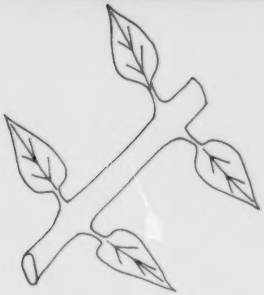
Ovate
or Egg-shaped

Oblanceolate

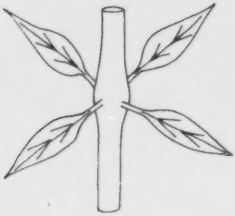
Obovate



Alternate



Opposite



Whorled

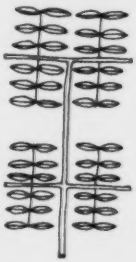
Figure 4. Leaf Arrangement

Figure 5. Simple and Compound Leaves

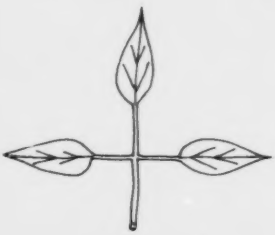
Simple Leaf

Pinnate

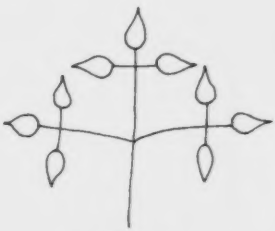
Bipinnate



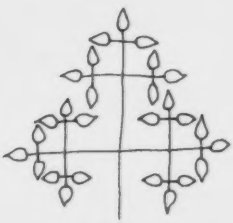
Tripinnate



Trifoliate
or Ternate



Biternate
or Two times ternate



Triternate
or Three times
ternate

Figure 6. Leaf Margins and Venation

Entire

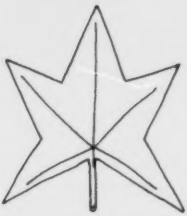
Singly Toothed

Doubly Toothed

Round-Toothed

Ciliate Margined

Palmately Lobed and Veined



Palmately Cleft

Parallel Veined

Pinnately Veined

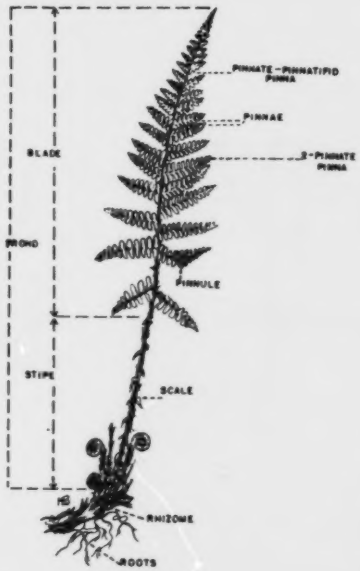
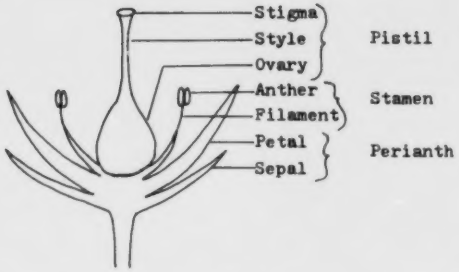
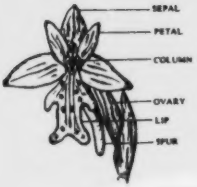


Figure 7. Parts of a Fern

Figure 8. Parts of a Flower



Generalized Flower Structure



Orchid Flower Structure

Figure 9. Vegetative Parts of Grasses

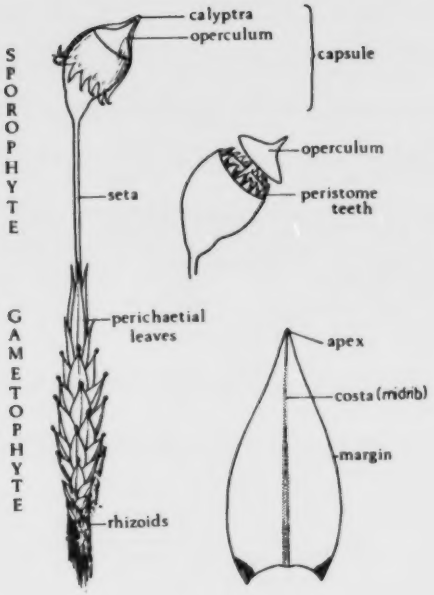


Figure 10. Parts of a Moss

Carbonates: free lime ($CaCO_3$) present in the soil as recognized by effervescence with 10% HCl.

Coarse Fragments: soil material larger than 2 mm diameter at the median axis (Appendix 2), consisting of gravels, cobbles and stones. The amount of coarse fragments is assessed as a percentage of total soil volume.

Fine Fraction: soil material smaller than 2 mm diameter (ie. sand, silt and clay). Soil texture is determined on the fine fraction materials. (Appendix 2).

Floodplain: the area bordering a stream or river which is frequently inundated during the flood stage, and which is composed of river (fluvial) deposits.

Fluvial: generally sorted materials composed largely of rounded gravels and sand deposited by streams and rivers.

Fragmental: soils having greater than 70% by volume of coarse fragments and with too little fine fraction to fill interstices larger than 1 mm (Appendix 3).

Gleying: saturated soil conditions over long periods, with an associated low oxygen content produces conditions under which soil minerals, particularly Iron, are reduced, termed gleying. Periodic drying permits some oxidation which produces mottles. Gleyed soils are usually a grey colour or have prominent mottles or both.

Lacustrine: deposits of sand, silt and clay originally accumulated in a lake bed. They are usually layered (varved) as a result of annual variations in deposits and are lacking in coarse fragments.

Mottling: results from periodic saturation of the soil causing a cycle of reducing-oxidizing conditions which produces spots and blotches (mottles) of different colours (usually reddish or grey) in the soil.

Organic soils: soils composed largely of decomposing plant material. As applied in this guide the term refers to accumulations of organic material greater than 40 cm deep usually occurring on poorly to very poorly drained sites.

Receiving sites: sites, generally in a lower slope position, which receive moisture through subsurface groundwater flow (seepage) in addition to precipitation.

Restricting layer: a layer in the soil which restricts the penetration of moisture or roots. This may be bedrock, cemented soil horizons, extremely compacted materials or layers with chemical concentrations such as carbonates.

Seepage: subsurface water flow, apparent at some depth in a soil pit, resulting from the gravitational movement of water downslope. It often occurs at lower slope positions (receiving sites) or over impervious soil layers.

Skeletal: soils having between 35 and 70 percent, by volume, of coarse fragments but also having enough fine fraction materials to fill interstices larger than 1 mm. This category is further subdivided into Particle-Size Classes on the basis of fine fraction texture (Appendix 3).

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Adenocaulon bicolor

Drosera anglica - leaf close-up

Cinna latifolia

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Calliergon stramineum

Roellia roellii

Mnium nudum

Marchantia polymorpha

Mnium rugicum

Plagiothecium laetum

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Figures 3, 4, 5, 6 and 8 (Generalized Flower Structure)

Appendix I

Recommended Plant Identification Guides

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Appendix II

ESTIMATING SOIL TEXTURE IN THE FIELD

Soil texture is the relative proportions of the various "size fractions" of a soil. The coarse fragments consist of particles greater than 2 mm in diameter. The fine fraction consists of particles less than 2 mm in diameter (for non-spherical particles see accompanying figure.). Particles of the two size fractions are defined on the accompanying figure. Coarse fragments are estimated visually as a percentage of the whole soil: % stones + % cobbles + % gravels + % fine fraction = 100% (Total soil)

% sand + % silt + % clay = 100% (Fine fraction)

The relative proportions of fine fraction particles (sand, silt and clay) are estimated through the use of their unique properties of "feel". Sand can always be felt as individual grains, but silt and clay generally cannot. Dry silt feels floury and wet silt is slippery or soapy, but not sticky. Dry clay forms hard lumps, is very sticky when wet, and plastic (like plasticene) when moist.

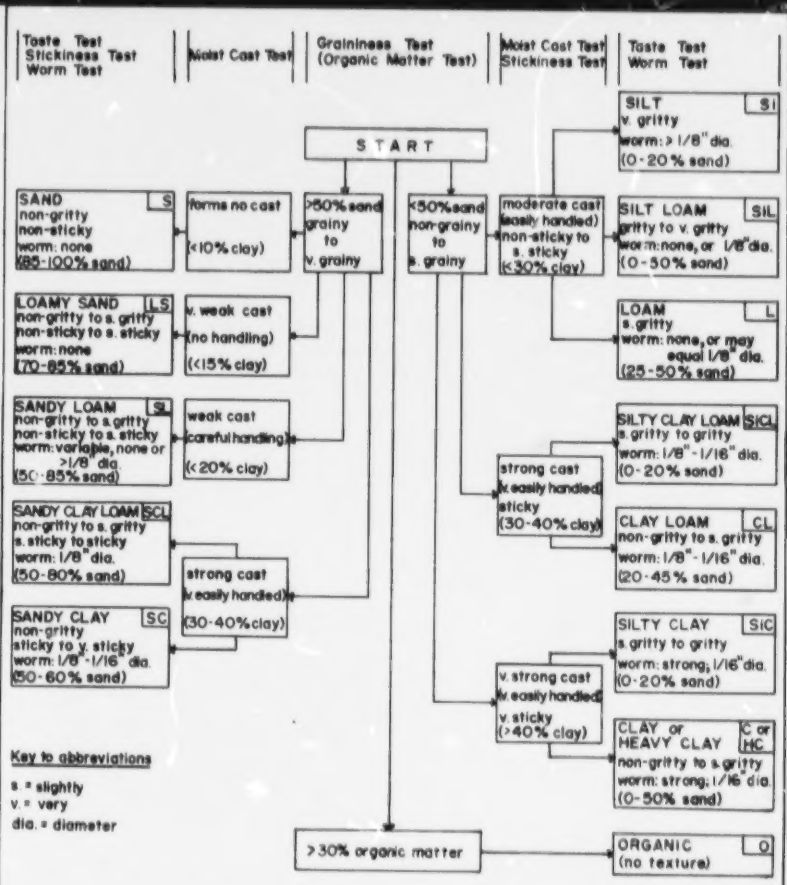
Most soils are a mixture of sand, silt and clay, so the graininess, slipperiness or stickiness will vary depending upon how much of each particle size is present. As the amount of clay increases, soil particles bind together better, form stronger casts, and longer, stronger worms. As sand and silt increase the soil binding strength decreases, and only weak to moderately strong casts and worms can be formed. The various classes of soil texture defined on the textural triangle in the accompanying figure are named by a combination of the dominant particle size and the term loam meaning a relatively even mix of the three.

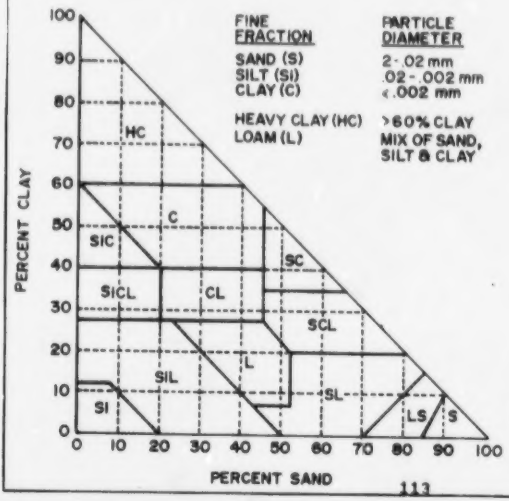
The field determination of soil texture is very subjective and can only be done consistently with training and experience. The field tests outlined below, used in sequence with the accompanying flow chart are provided to assist in the field determination of soil texture:

1) Graininess Test: Rub the soil between your fingers. If sand is present, it will feel "grainy". Determine whether sand comprises more or less than 50% of the sample.
2) Moist Cast Test: Compress some moist soil by clenching it in your hand. If the soil holds together(i.e. forms a "cast"), then test the durability of the cast by tossing it from hand to hand. The more durable it is, the more clay is present.
3) Stickiness Test: Wet the soil thoroughly and compress between thumb and forefinger. Degree of stickiness is determined by noting how strongly the soil adheres to the thumb and forefinger upon the release of pressure, and how much it stretches. Stickiness increases with clay content.
4) Worm Test: Roll some moist soil between the palms of your hands to form the longest, thinnest worm possible. The more clay there is in the soil, the longer, thinner and more durable the worm will be.
5) Taste Test: Work a small amount of soil between your front teeth. Silt particles are distinguished as fine "grittiness", unlike sand which is distinguished as individual grains (i.e. graininess). Clay has absolutely no grittiness at all.

Well decomposed organic matter (humus) imparts silt-like properties to the soil. It feels floury when dry and slippery when moist, but not sticky and not plastic. However, when subjected to the taste test, it feels non-gritty. It is generally very dark when moist or wet, and stains the hands brown or black. Humus-enriched soils often occur on wet sites in association with a heavy moss cover, and on grassland sites. Humus is not used as a determinant of soil texture, so an estimate of the silt content of any humus-enriched mineral soil should be reduced accordingly.

"Organic" soil samples are those that contain more than 30% organic matter. Soil texture is not determined on organic samples. Most organic soils and deep organic horizons are found on wet sites, often in depressions or on flood plains, and in association with a dense moss cover, frequently Sphagnum Spp.

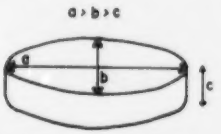




FINE FRACTION	PARTICLE DIAMETER
SAND (S)	2 - .02 mm
SILT (Si)	.02 - .002 mm
CLAY (C)	< .002 mm
HEAVY CLAY (HC)	>60% CLAY
LOAM (L)	MIX OF SAND, SILT & CLAY

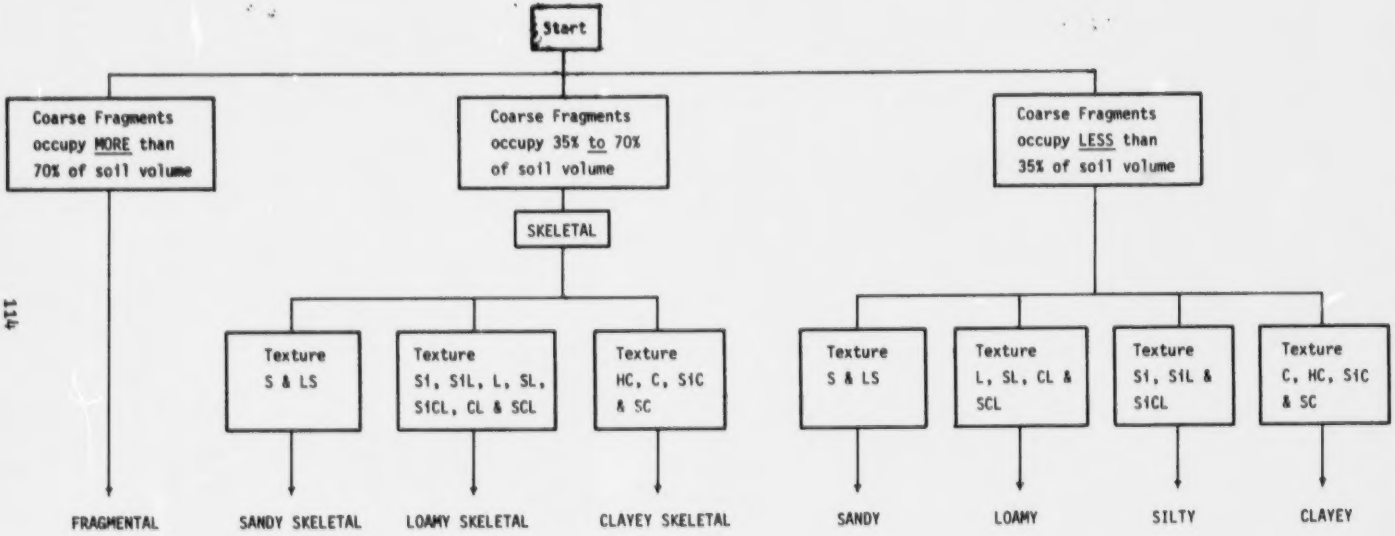
COARSE FRAGMENTS	PARTICLE DIAMETER
STONES	>250 mm
COBBLES	250 - 75 mm
GRAVELS	75 - 2 mm

PRINCIPLE AXES OF A COARSE FRAGMENT



coarse fragment size is always determined along the b-axis

Appendix 3. A guide to Soil Particle-Size Classes


Start
Coarse Fragments occupy MORE than 70% of soil volume
Coarse Fragments occupy 35% to 70% of soil volume
Coarse Fragments occupy LESS than 35% of soil volume
SKELETAL
Texture S & LS
Texture Si, SiL, L, SL, SiCL, CL & SCL
Texture HC, C, SiC & SC
Texture S & LS
Texture L, SL, CL & SCL
Texture Si, SiL & SiCL
Texture C, HC, SiC & SC
FRAGMENTAL
SANDY SKELETAL
LOAMY SKELETAL
CLAYEY SKELETAL
SANDY
LOAMY
SILTY
CLAYEY

* Coarse Fragments: soil material greater than 2 mm diameter at the b axis (See Appendix 2).

* Texture: determined on fine fraction materials (See Appendix 2).

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NOTES

Request for Revisions

It is anticipated that some additions and revisions will be made to this publication as further work is completed in the Nelson Forest Region. To ensure that you receive copies of these changes please write your name and address below and mail to:

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B. C. Ministry of Forests
518 Lake Street
Nelson, B. C. V1L 4C6

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